

# **NBS/NPS VEGETATION MAPPING PROGRAM**

## **Vegetation Classification of Thomas Stone National Historic Site**

A red rectangular stamp with rounded corners and a thick border. The word "DRAFT" is written in the center in a bold, red, serif font. The stamp has a slight drop shadow.

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# Vegetation Sampling and Classification - Thomas Stone National Historic Site

## INTRODUCTION

**DRAFT**

### **Purpose of study:**

The purpose of this study is to classify and describe vegetation at Thomas Stone National Historic Site (NHS) within the framework of the National Vegetation Classification System (NVCS) (Grossman et al., 1998), and in accordance with standards developed for units of the National Park system (The Nature Conservancy and Environmental Systems Research Institute 1994b). The National Park Service implemented a national program to provide vegetation maps (<http://biology.usgs.gov/npsveg>), which are one of the minimal data sets of an essential resource inventory element for managing more than 250 units of the National Park system with significant natural resources (<http://www.nature.nps.gov/im>). Vegetation units classified, described, and named to the association level of the NVCS (when possible) have been determined to be desirable for use as fundamental mapping units of the National Park Service Vegetation Mapping Program (The Nature Conservancy and Environmental Systems Research Institute 1994b). It is expected that the process of applying this classification to mapping of Thomas Stone NHS will begin in late 2002.

A second purpose of this study is to populate the NVCS with information on the floristic and environmental attributes and distribution of well-known, poorly known, and new vegetation types. The NVCS is currently under development, and many classification units in the hierarchy require more complete descriptions and/or more precise delimitations. Therefore, this study not only involves the application of an existing national taxonomic system to a local area, but is also *de novo* research and inventory. Known prior vegetation classification studies using the NVCS in the Inner Coastal Plain in Maryland have been limited to two studies of floodplain and non-tidal wetland vegetation by the Maryland Department of Natural Resources (Meininger and McCarthy 1998; Thomson et al. 1999). Thus, while this "first approximation" classification is likely to adequately define distinct vegetation units usable for resource management and resource planning, the naming and placement of these units within the NVCS may change following further review and/or continuing regional and national inventory efforts. Although formal mechanisms for updating circumscriptions and nomenclature in park classifications as the NVCS evolves do not yet exist, such changes are unlikely to affect significantly the applicability of the corresponding map for management.

### **Setting of study area:**

Thomas Stone NHS was established in 1978 and has been managed by the National Park Service since 1981. It is located 5 kilometers (3.1 miles) west of La Plata, in Charles County, Maryland (Figure 1). The area of the park is approximately 133 hectares (328 acres), of which about 130.5 hectares are federally owned land and about 2.5 hectares is a privately owned inholding (National Park Service 1990b). Approximately 2/3 of the site (90 hectares) is in relatively natural vegetation (forest, including some non-tidal wetlands), with the remainder comprised of fields and other forms of land cover that are maintained clear of trees for maintaining historic scenes or utility right-of-way (43 hectares) (Gailey and Shrout 1993) (Figure 2).

Elevations range from about 12 meters (40 feet) to just over 52 meters (170 feet) above sea level. The entire park unit lies within the watershed of Hoghole Run, a tributary of the Port Tobacco River. Mean annual precipitation for Charles County is 119 cm (47 inches) per year (Hall and Mathews 1974).

The primary significance of Thomas Stone NHS is its historic role as the home of Thomas Stone, a Maryland delegate to the Continental Congress and a signer of the Declaration of Independence. Management objectives for the site are (1) to preserve and protect the resources essential for commemorating Thomas Stone, (2) to manage and protect the natural resources of the site consistent with the need to interpret agrarian lifestyles and re-establish historic landscapes, and (3) to rehabilitate structural and landscape elements essential for interpreting Thomas Stone's home, 19<sup>th</sup> century farming practices, and buildings contributing to the site's history (National Park Service 1990a)

### **Geology and Soils:**

Thomas Stone NHS lies within the Western Shore [of the Chesapeake Bay] section of the Coastal Plain of Maryland (Shreve et al. 1910; Schmidt 1993). This region is also often called the Inner Coastal Plain. The Coastal Plain in Maryland is of low relief and underlain by unconsolidated sediments of primarily fluvial or estuarine origin, with the Western Shore consisting of generally older surficial material and having greater and more diverse topographic relief than the Eastern Shore (Schmidt 1993).

Most of the uplands in the area of Thomas Stone NHS are mapped as being underlain by unconsolidated deposits of Quaternary (Pliocene) age gravels and sands, with minor silts and clays (Cleaves et al. 1968). Larger streams, including at least the lower reaches of Hoghole Run, have exposed sediments of older [Tertiary] age. If they are exposed in the vicinity of Thomas Stone NHS, these older sediments are most likely represented by the Miocene age Calvert Formation and/or the Eocene age Nanjemoy Formation (Cleaves et al. 1968). Both are comprised of silts, clays, and argillaceous sands, with some marine fossils (Cleaves et al. 1968; Schmidt 1993).

Soil series mapping units for the area (Hall and Mathews 1974) indicate that the Beltsville-Gravelly Land-Bourne Association is the prevalent soil association at Thomas Stone NHS. Seven different soil series, composed of 12 unique mapping units, occur within the site boundaries (Table 1 and Figure 5).

The topographically higher (generally areas above 46 m (150 feet) above sea level), low slope areas are underlain by unconsolidated deposits of Pliocene age, here comprised mostly of the Beltsville silt loam (a typic fragiudult), with Exum silt loam (an aquic hapludult) and Sassafras sandy loam (a typic hapludult) occupying relatively minor areas. These are moderately well drained (Sassafras sandy loam is well drained), with a fragipan in the subsoil that inhibits downward water movement characteristic of the Beltsville silt loam. Field inspection indicated that areas mapped as the Beltsville silt loam consistently had a fragipan of high clay content, the top of which was generally from 5 to 25 cm below the soil surface and which was barely to not penetrable by a soil sampling probe.

Where streams such as Hoghole Run and its tributaries have dissected the landscape much below the elevation of these upper deposits (generally between 30 and 46 meters (100-150 feet) above sea level in the northern part of the site and between 15 and 46 meters (50-150 feet) in the southern part), the surface is predominantly gravelly deposits. The soil series represented most prominently in these situations at Thomas Stone NHS are the Aura gravelly sandy loam and, to a lesser extent, the Croom gravelly loam (both typic hapludults). Field inspection confirmed that areas mapped as either of these series had soils that were consistent with descriptions of the series in Hall and Mathews (1974). They can be consistently identified at the site by rounded gravel particles up to 5 cm (2 inches) in diameter.

Alluvial soils along Hoghole Run, which occupy the lowest elevations at the site, are recent soils of alluvial origin (Hall and Mathews 1974). These are dominated by the Bibb silt loam (a typic haplaquent), which predominates near the channel, with Mattapex fine sandy loam (an aquic hapludult) often present in slightly higher areas.

### **Floristic setting:**

Little information on flora or vegetation specific to Thomas Stone NHS is known to exist. A forest stewardship plan developed for the site (Gailey and Shrout 1993) examined stands of forest and presented brief descriptions of tree and shrub species composition, stand age, and past forest use. While the plan provides some information on past land history that is useful for understanding some vegetation patterns, it does not contain sufficient detail about stand floristic composition to be of great use to vegetation classification.

In an early description of the vegetation of Maryland, Shreve et al. (1910) provided some general information about vegetation of the region which is useful and somewhat applicable today. They defined three upland forest and four lowland forest associations (defined more broadly than the concept of the association of the NVCS) for the Western Shore District of the Coastal Zone, their designation for the phytogeographic area of which Charles County is part. They also described distribution and frequency of common tree species in these forests and forest successional patterns. From descriptions of composition of several upland stands by Shreve et al. (1910), it is evident that chestnut (*Castanea dentata*) was an important component of mature dry forests on much of the Western Shore before the onset of chestnut blight in Maryland. It may have formerly been a component of forests at Thomas Stone NHS, which would be considered to lie within the Oak-Chestnut Forest Region in the sense of Braun (1950), with some elements characteristic of the Oak-Pine Region present.

As part of an effort to develop a statewide classification of vegetation using the NVCS, the Maryland Department of Natural Resources conducted two studies of riparian vegetation that included areas in Charles County. The first (Meininger and McCarthy 1998) was specific to the non-tidal wetlands of Zekiah Swamp, a riparian system within Charles County that constitutes the next large first order tributary of the Potomac River to the east of the Port Tobacco River. Meininger and McCarthy (1998) described four bottomland forest associations for that system. Thomson et al. (1999) conducted a survey of floodplain forest vegetation for the Potomac River and its tributaries within Maryland; the authors described fourteen association, with several occurring in Charles County.

State and regional classifications that include the area of the Inner Coastal Plain of Maryland and Virginia have synthesized data and descriptions from individual projects employing the NVCS. These include NatureServe Explorer (2001) and Fleming et al. (2001).

### **Land Use History:**

The estate known as Haberdevventure, within which present-day Thomas Stone NHS is located, was patented in 1682 (DeNadai et al. 1994). Although knowledge of early history of the site is incomplete, it is likely that most or all forests at the site have been cleared for agriculture and/or cut for wood periodically or continuously since at least that time.

Gailey and Shrout (1993) identified four forest stands within the park. They estimated that some trees were up to 120 years old and that some stands may have remained continuously forested for up to 250 years. They noted that harvesting of trees took place in the 1970s, including apparent commercial logging of some stands immediately before the National Park Service acquired the property (in 1978). Aerial photographs taken in 1937, 1957, and 1989 indicate that most areas forested today (Figure 2) have been continuously forested since at least 1937 (DeNadai et al. 1994).

## **METHODS**

### **Planning:**

Planning for field work and data collection generally follow the methodology developed by the U.S. Geological Survey/National Park Service Mapping Program (The Nature Conservancy and Environmental Systems Research Institute 1994a). The following is a summary of these methods as applied to Thomas Stone NHS.

Thomas Stone NHS is considered to be either "small" or "medium" sized park (i.e., a park in which the sample area is the entire land area of the unit) (The Nature Conservancy and Environmental Systems Research Institute 1994a). Decisions regarding number of plots and plot placement by environmental stratification were based on the whole park (in contrast, in large parks, the plot placement and stratification is focused on only a section of the park, and results are extrapolated to the whole park).

Because the natural vegetation of the park comprises an area small enough (about 80 hectares) to feasibly visit nearly all vegetation stands and because aerial photographs useful for delineating vegetation were not initially available, initial planning focused on visiting the park and attempting to observe the entire range of vegetation and pertinent environmental conditions on the ground. It is assumed that ground reconnaissance alone was successful in identifying representative stands of all individual vegetation assemblages that could potentially represent different associations within the NVCS.

About one third of the land area of the site is occupied by vegetation that would be considered to be within the Cultural Subgroup within the NVCS framework (Grossman et al. 1998). This category includes types that are actively managed by humans to prevent natural vegetation from succeeding. At Thomas Stone NHS, such vegetation includes pastures and lawns maintained as part of the historic scene and as utility line corridors passing through the park. While Cultural



vegetation can be described within the framework of the NVCS, precise assignment within the NVCS hierarchy based on floristic composition is problematic for several reasons. First, composition is less linked to observable environmental conditions than is that of natural and semi-natural types and is therefore less predictable on a phytogeographic basis. Second, the NVCS has been developed primarily as a tool for evaluating biological diversity, and Cultural subgroup types have not been evaluated extensively or consistently. Finally, precise floristic classification and description are seldom used for management of Cultural vegetation. Nevertheless, Cultural types represent a significant amount of land area that must be accounted for in a vegetation mapping project. Cultural types at Thomas Stone NHS were evaluated and described from qualitative observation only. Although they were tentatively assigned to associations, most Cultural vegetation subgroup vegetation could be classified with high confidence only to the class formation level (the finest physiognomic level) of the NVCS. Floristic descriptions for these are limited to the minimal amount necessary to recognize them in the field. Unvegetated land cover (e.g., roads, buildings) and natural aquatic communities (e.g., ponds, permanently flooded parts of stream channels) that are typically identified in mapping projects as non-vegetated land cover are not included in this classification.

The principal investigator made an initial one-day reconnaissance visit to the park with the park Resource Management Specialist in December, 2000. The objectives of this visit were to examine the general composition of the vegetation, to observe environmental factors affecting composition, and for the principal investigator to become familiar with access points and other logistics needed for planning vegetation and environmental data sampling.

#### **Data collection:**

In late May, 2001, the principal investigator made a two-day site visit to conduct a "rapid assessment" of the park vegetation. The purposes of this initial systematic assessment was to (1) observe a large number of vegetation stands representing the full range of vegetation diversity, (2) to collect limited quantitative (tree species composition) and qualitative (dominant or characteristic species) that could be used to divide vegetation into preliminary broad classes that would serve as strata for maximizing the efficiency of more intensive plot sampling of vegetation, and (3) to record the position of these points for "retro-classification" that would increase the number of spatially referenced and classified training points that could be useful for future guidance in the interpretation of remote sensing images. Observation points (Table 2 and Figure 3) were chosen subjectively to cover the full range of environmental factors and combinations of these factors that would be expected to exert the greatest influence on vegetation composition. Factors perceived to be most significant in affecting vegetation composition included topographic position, hydrology, soil type [series], slope, aspect, and degree of recovery from prior anthropogenic disturbance; some factors proved to be highly correlated with one another. The large number of points from which observations could be made using this method and the limited size of the park was relied on to ensure that major vegetation types would not be missed.

At each observation point, the investigator rotated in a full circle and counted the number of trees of each species filling the basal area factor 5 opening of a Jim-Gem® Cruz-All timber cruising tool, as viewed from the stationary observation point. Such a count yields an estimate of the basal area of each species in square feet per 0.2 acre ( $= \text{m}^2 / 0.871 \text{ hectare}$ ). Notes were made on

dominant and/or characteristic understory species. The position of each observation point was recorded using a Trimble Pro XR Global Positioning System (GPS), with most positions corrected by real-time radio link. For several points recorded during a loss of radio link, differential correction was conducted in Trimble Pathfinder software, using data collected simultaneously at a Charlottesville, Virginia base station. The recorded positions of all observation points are considered to be accurate to within 2 meters of the actual positions.

The rapid assessment data were entered into a Microsoft Excel spreadsheet and converted to a format suitable for analysis using PC-ORD v. 3.04 (McCune and Mefford 1997). The Two-Way Indicator Species Analysis (TWINSPAN) (Hill 1979) program module was used to identify major groups of vegetation using the rapid assessment (tree basal area) data, with cut levels set at 1,2,3,4,5,6,8,10, and 12 trees/point ( $= \text{m}^2 / 0.871 \text{ hectare}$ ). These results (Table 3) were used to identify vegetation stands that would represent the most efficient array of plot data collection for identifying all NVCS associations likely to occur at the site and for fully describing the range of vegetation occurring at the site within the respective associations.

In July, 2001, seven National Park Service staff conducted vegetation and environmental data collection at 23 plots (Table 4 and Figure 4) from representative stands identified from analysis of rapid assessment data, and in small patch vegetation types that were identified in the field as likely representing distinct types. Plots were subjectively placed so as to be most representative of the stand. Most plots were 400 square meters in area, with the default dimensions of 16 meters x 25 meters. This plot size is the standard size that is used by the National Park Service Vegetation Mapping Program for forest stands (The Nature Conservancy and Environmental Systems Research Institute 1994a). The plot dimensions used here were selected as being optimal between the greater efficiency of rectangular plots for recovering natural vegetation composition patterns and the greater ease of setting up and reading plots in which length and width are more nearly equal. One 12.5 m x 32 m plot was employed to keep sampling within a long, narrow stand, and two 100 square meter plots were used for both examples of a small patch type.

In early August, 2001, data were collected from three additional plots, so that the study plot sample was represented by a total of 26 plots.

Field crews visually divided the vegetation in each plot into strata (tree canopy, tree subcanopy, tall shrub, short shrub, herbaceous), and listed all the vascular plant species of each stratum. For all species found in the plots, the abundance of each species in each stratum was recorded as belonging to one of nine cover classes (Fleming et al., 2001), with zero scored if a species were absent in a stratum. Total abundance for each species for the plot was not estimated separately, but was calculated by summing the individual midpoints for each cover range represented by the corresponding cover class value for the species in each stratum and converting this sum to the appropriate cover class. Additional species within the vegetation unit or polygon that occurred outside of sampled plots were listed separately. The cover of plants that could not be identified with confidence was recorded for plots in which they were found, but these data were not included in subsequent analyses.

In addition to floristic data, the following environmental information was recorded on field forms: soil profile description, flooding regime, soil moisture regime, soil texture, slope, aspect, and evidence of disturbance. A topographic cross-section profile was sketched by hand to represent the location and setting of the plot. Three soil samples were taken from subjectively chosen representative locations within the plot by inserting a 1.905 cm (3/4 in) diameter soil probe at least 25 cm (when possible) beneath the soil surface to extract the sample. A soil profile depicting changes in soil color and composition with depth was sketched for each 25 cm deep soil sample. Soil texture was subjectively assessed by a consensus of three feel tests (one from each soil sample) of material from the B horizon, whenever stratification was evident and whenever possible (The Nature Conservancy and Environmental Systems Research Institute 1994a). In cases in which soil stoniness or a fragipan prevented collection from the B horizon, the sample was taken from as deep within the A horizon as possible. Soil pH was assessed by placing a sample of 10-15 cubic cm of B (or deep A) horizon soil from each soil sample into a vial and mixing it with deionized water to form a slurry with a total volume of 30 ml. The slurry was allowed to stand for at least 5 minutes and the pH measured with a soil pH test meter (Oakton model WD-35624-66). The mean of the three sample pH readings was recorded as the measure of soil pH for the plot. The meter was thoroughly rinsed with deionized water between sample tests and calibration was checked against a pH 7.0 buffer solution before and after each day of use. For two plots in seepage swamps with emerging groundwater present, the pH of the surface water, rather than soil, was measured.

The position of the center of each plot was visually estimated and recorded by a GPS, and the GPS data were processed as described for the rapid assessment points. Slope and aspect for each plot were estimated by plotting the plot position in ArcView Geographic Information Systems software onto slope and aspect model maps generated from digital elevation models, in turn derived from U.S. Geological Survey 7.5 minute quadrangle hypsography (digital line graph) data. Plotting vegetation plot positions onto a digital version of the Charles County soil map (Hall and Mathews 1974) derived the soil series represented by each plot.

Additional environmental data, as specified on Field Form 3 (The Nature Conservancy and Environmental Systems Research Institute 1994a), were recorded in the field.

For stands that were classified as Cultural or very early successional Natural/Semi-natural vegetation, quantitative data were not collected, but lists of dominant or characteristic species were made.

### **Data analysis:**

Plot vegetation data were analyzed using TWINSpan, as for the rapid assessment data, with the nine cover value levels being used as cut levels. Plot data from potentially similar vegetation from the studies of Meininger and McCarthy (1998) and Thomson et al. (1999) were converted to the cover scale that was used in this study, and the three data sets were combined and analyzed in several combinations. The output tables from these analyses were used in combination with descriptions from these studies and regional descriptions (Fleming et al. 2001; NatureServe Explorer 2001) to assign vegetation into units within the existing framework of the NVCS. The relationships among and between hypothetical groups (associations) were checked by calculating Bray-Curtis percent similarities (Ludwig and Reynolds 1988) between all possible combinations

of plot pairs. Individual descriptions of each association were written in the format of Grossman et al. (1998). To assist mapping efforts, rapid assessment points were retrospectively assigned to vegetation types that were described from the plot data analyses and the literature review.

## RESULTS

TWINSPAN analysis (Table 5) of the rapid assessment points identified four broadly-defined vegetation groups, all of which were forested: 1) a dry oak - dominated group, 2) a dry pine-oak group, 3) a dry-mesic slope group, 4) a mesic slope group dominated by tulip tree, and 5) a floodplain forest group. These data suggested stands for plot sampling designed to more precisely define and describe vegetation types at the association level of the NVCS at Thomas Stone NHS, and 23 plots were placed within stands representing one of these preliminary types. Three stands representing two small patch types not included in the rapid assessment were identified, and all plot data were collected for each of these stands. Since the small patch types were clearly distinct from the remainder of the vegetation, they were omitted from the TWINSPAN analyses as probable outlier sample units that would likely tend to obscure more subtle patterns of variation, and plot data obtained from them were used primarily for descriptive purposes.

Analyses of data from the 26 plots and comparison with existing descriptions (e.g., Fleming et al. 2001; NatureServe Explorer 2001) suggested that the five preliminary groups represented seven NVCS Natural/Semi-Natural Alliances, and that two additional Natural/Semi-Natural Alliances represented by the small-patch stands were also present. All nine of these types are in the NVCS physiognomic class of Forest. Qualitative observations and species lists identified that three more Natural/Semi-Natural Alliances (one Forest or Shrubland, one Woodland, and one Herbaceous Vegetation) and three Cultural Alliances (all Herbaceous Vegetation) were also present, to represent a total of 12 Natural/Semi-Natural Alliances (and Associations) and three Cultural Alliances (and Associations).

Table 5 depicts the TWINSPAN output for 23 plots, with their final assignment within seven vegetation types identified. It shows the relationships of these plots within the context of Thomas Stone NHS only. Other considerations, including analyses of subsets of the Thomas Stone NHS data with other data sets, analysis of the percent similarities among and between putative associations (Table 6), comparison of data and observations from Thomas Stone NHS data to existing descriptions, and ecological judgment were used to ultimately define the types represented at Thomas Stone NHS and to establish the best assignment of the plots within this classification.

The splitting of the five original groups into seven was made after it was found that what was originally perceived to be variation within two of the original groups identified at the site apparently represented a crossing of conceptual boundaries between related associations that previously had been distinguished at the Alliance level of the NVCS (Meininger and McCarthy 1998; Thomson et al. 1999; NatureServe Explorer 2001) or ecological group level of the Virginia state classification (Fleming et al. 2001).

Because it is expected that associations defined for this area will undergo additional review and some revision in the near future, there is a higher degree of confidence in assignment of types to the NVCS alliance level than to the association level. Since only one association per alliance is present at Thomas Stone NHS in the case of Natural/Semi-Natural alliances, this uncertainty would appear to have little effect on developing ecologically meaningful descriptions and maps for natural resource management at the park level. It is generally a much more straightforward matter to partition vegetation from a small geographic area, such as a National Park, into meaningful ecological units than it is to place them accurately and consistently within a classification framework encompassing a much larger geographic scale. An additional difficulty of taxonomic placement of local vegetation within the NVCS is that the NVCS is a relatively new classification system, with some vegetation descriptions not yet well or consistently documented by data and/or have had not had adequate analysis and review across larger geographic areas.

The analysis of the combined data from Thomas Stone NHS and the studies of Meininger and McCarthy (1998) and Thomson et al. (1999) showed some insight into how patterns in vegetation found at Thomas Stone NHS were expressed at a larger (one to two county) geographic scale. However, because of possible confounding due to observer or spatial bias, the benefits of this analysis were limited, in some cases, to understanding consistent patterns in variation in vegetation in the region, and it was not always possible to reconcile the concepts of associations described by the three studies. It is likely that informal observation and comparisons in the study areas of the two Maryland Department of Natural Resources studies could resolve some of this uncertainty.

Vegetation descriptions of associations for Thomas Stone NHS include geographic range (of the alliance), environmental description (at Thomas Stone NHS), USFWS wetland system (Cowardin et al. 1979), most abundant species (at Thomas Stone NHS), diagnostic species (at Thomas Stone NHS), conservation rank (global rarity rank) with justification, and confidence level of classification. In addition, numbers of plots from Thomas Stone NHS representing the association are listed.

Conservation rank is on a scale from G1 to G5 with G1 being globally rare, and G5 being widespread and common. Accurate assignments of conservation ranks of associations at Thomas Stone NHS will require further review of the classification assignment of the association within the NVCS, but it is expected that most will prove to be ranked at the G4 or G5 level. Confidence level of classification was rated on a scale of 1, 2, or 3, and applies to assignment of the type at Thomas Stone to the correct NVCS alliance.

All classified plot and rapid assessment point locations for Thomas Stone NHS will be transferred to a project base map, where they will assist interpretation of photo-mosaic images and/or aerial photographs during the mapping phase of this project.

## **DISCUSSION**

Thomas Stone NHS lies in the Inner Coastal Plain (Western Shore District of the Coastal Zone of Shreve et al. (1910)) of Maryland. This area is floristically more related to the outer Piedmont

than it is to the outer Coastal Plain, and types described at Thomas Stone NHS follow vegetation patterns similar to those described for terrain at Rock Creek Park (The Nature Conservancy 1998), with identical or analogous types occurring in similar environmental situations. The highly dissected topography and hydrological conditions at Thomas Stone NHS are largely responsible for a surprisingly high number of natural/semi-natural vegetation types (12) occurring within only 93 hectares of primarily natural vegetation. Patterns of anthropogenic disturbance also contribute to this diversity by producing a gradient of forest seral stages. In general, the upland types appear to be fairly widespread types occurring in the Piedmont and perhaps other physiographic provinces, while floodplain and wetland types are more likely to be found to be characteristic of the Coastal Plain only in Maryland or the Coastal Plain and Piedmont in Virginia.

The three environmental factors determining vegetation type at Thomas Stone NHS are (1) topographic position/slope/soil (all highly correlated), (2) hydrologic regime, and (3) seral stage. Table 7 shows the strong correlations between soil series and vegetation association. Figure 6 shows the relationships of slope and aspect to vegetation type and shows that vegetation type is well correlated with slope. Aspect (compass direction) does not appear to influence vegetation composition greatly, although slope shape (concave versus convex) may.

Three dry forest types dominate natural vegetation of the upland (interfluvial) areas of Thomas Stone NHS, which are primarily of low slope and underlain by soils of the Beltsville and Exum series (Hall and Mathews 1974). Two early successional forests (*Pinus virginiana* - *Quercus alba*, *stellata*, *falcata*, *velutina*) - *Liquidambar styraciflua* Forest and *Liquidambar styraciflua* Forest), and two mature dry forest types (*Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest and *Quercus alba* - *Quercus coccinea* / *Gaylussacia baccata* Forest) are present. Where the forest has been cleared for maintenance of the historic scene, two Cultural associations (Lawn and Dry Meadow) are present. A single small area of seasonally flooded soil hydrology (upland depression) supports a small patch wetland type (*Liquidambar styraciflua* - *Acer rubrum* - *Quercus phellos* Forest) and an anthropogenic wetland supports a Natural/Semi-Natural wetland association (Pond Shore Marsh).

Two associations dominating upland slopes (on areas moderate to steep slopes and occupied by the Aura, Croom, Mattapex, or Sassafras soil series) are the mesic or dry-mesic *Liriodendron tulipifera* / *Lindera benzoin* Forest and the dry-mesic *Fagus grandifolia* - *Quercus rubra* - *Quercus alba* / *Carpinus caroliniana* Forest. The former association appears to be an early seral expression of the latter and possibly also of a mixed mesophytic type that occurs in other areas of Charles County, but not at Thomas Stone NHS. Where lower parts of upland slopes merge with ravine bottoms, local areas of saturated surface soil hydrology (seepages) support a wetland association, the *Acer rubrum* - *Nyssa sylvatica* - *Magnolia virginiana* Forest.

Three Natural/Semi-Natural types occur on bottomlands (low to moderate slopes underlain by the Aura, Mattapex, or Bibb soil series). These are temporarily to seasonally flooded and occupy a gradient of less hydric to more hydric situations (e.g., from higher to lower order streams, from a topographically higher and less frequently flooded to a lower and more frequently flooded position on the same floodplain, and/or from a position over a water table deeper below the soil surface to one over a more shallow water table). The *Liriodendron tulipifera* - *Acer rubrum* -

*Liquidambar styraciflua* / *Thelypteris noveboracensis* Forest occurs along [ravine] bottoms of lower order streams and probably on relatively higher positions of the Hoghole Run floodplain. The *Liquidambar styraciflua* - *Quercus palustris* / *Cinna arundinacea* Forest occurs along the floodplain of higher order streams (Hoghole Run), and the *Betula nigra* Woodland occurs within the channel of higher order streams. A Cultural type (Wet Meadow) occurs where the floodplain has been cleared for utility line corridors.

For some Forest associations, all or most of the stands present at Thomas Stone NHS are relatively early seral examples, due to relatively recent land clearing. They may be identifiable to existing NVCS types, but may not be exemplary stands for describing these types because of the relative importance of early seral generalist species which are less sensitive indicators of natural environmental conditions. Nevertheless, in view of the fact that data and descriptions of these types from a representative sample of their geographic extent are likely lacking, examples of vegetation from Thomas Stone NHS are likely to prove to be useful for guiding state and regional development of the NVCS.

Because of the relatively high importance of American Chestnut (*Castanea dentata*) in dry upland forests of the Western Shore noted by Shreve et al. (1910), it is possible that this species was once a component of drier forests at Thomas Stone NHS. Floristic studies should search for American chestnut saplings or other evidence of the possible former frequency of this species.

## Vegetation Classification - Thomas Stone National Historic Site

Following is the vegetation classification for Thomas Stone NHS, set within the hierarchy of the National Vegetation Classification System (Grossman et al. 1998). For each association, the alliance name, the association Latin name, the association common name, and the association synonym are listed.

### I. Forest

#### IB. Deciduous forest

#### IB2. Cold-deciduous forest

#### IB2N. Natural/Semi-Natural vegetation

#### IB2Na. Lowland or submontane broad-leaved cold-deciduous forest

*Fagus grandifolia* - *Quercus rubra* - *Quercus alba* Forest Alliance  
*Fagus grandifolia* - *Quercus rubra* - *Quercus alba* / *Carpinus caroliniana*  
**Forest**  
*Liquidambar styraciflua* Forest Alliance  
*Liquidambar styraciflua* Forest (*Liquidambar styraciflua* Shrubland)  
*Liriodendron tulipifera* Forest Alliance  
*Liriodendron tulipifera* / *Lindera benzoin* Forest  
*Quercus alba* - (*Q. coccinea*, *Q. velutina*) Forest Alliance  
*Quercus alba* - *Quercus coccinea* / *Gaylussacia baccata* Forest  
*Quercus velutina* - *Quercus alba* - (*Quercus. coccinea*) Forest Alliance  
*Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest

#### IB2Nd. Temporarily flooded cold-deciduous Forest

*Liquidambar styraciflua* - (*Liriodendron tulipifera*, *Acer rubrum*)  
Temporarily Flooded Forest Alliance (?)  
*Liriodendron tulipifera* - *Acer rubrum* - *Liquidambar styraciflua*/*Thelypteris noveboracensis* Forest

#### IB2Ne. Seasonally flooded cold-deciduous forest

*Liquidambar styraciflua* - (*Acer rubrum*) Seasonally Flooded Forest Alliance  
*Liquidambar styraciflua* - *Acer rubrum* - *Quercus phellos* Forest  
*Quercus palustris* - (*Quercus bicolor*) Seasonally Flooded Forest Alliance  
(?)



***Liquidambar styraciflua* - *Quercus palustris* / *Cinna arundinacea* Forest**

IB2Ng. Saturated cold-deciduous forest

*Acer rubrum* - *Nyssa sylvatica* Saturated Forest Alliance

***Acer rubrum* - *Nyssa sylvatica* - *Magnolia virginiana* Forest**

IC. Mixed evergreen-deciduous forest

IC2. Mixed broad-leaved evergreen cold-deciduous forest

IC2N. Natural/Semi-Natural vegetation

IC2Na. Mixed needle-leaved evergreen cold-deciduous forest

*Pinus virginiana* - *Quercus* (*alba*, *stellata*, *falcata*, *velutina*) Forest

Alliance

***Pinus virginiana* - *Quercus* (*alba*, *stellata*, *falcata*, *velutina*) -**

***Liquidambar***

***styraciflua* Forest**

II. Woodland

IIB. Deciduous woodland

IIB2. Cold-deciduous woodland

IIB2N. Natural/Semi-Natural vegetation

IB2Nb. Temporarily flooded cold-deciduous Woodland

*Platanus occidentalis* - (*Betula nigra*, *Salix* spp.) Temporarily Flooded  
Woodland Alliance

***Betula nigra* Woodland**

V. Herbaceous Vegetation

VA. Perennial graminoid vegetation

VA5. Temperate or subpolar grassland

VA5N. or VA5C. Natural/Semi-Natural or Cultural vegetation

VA5Nc. or VA5Cc. Medium-tall sod temperate or subpolar grassland

*Festuca* spp. Herbaceous Alliance

**Dry Meadow**

**Lawn**

VA5Nk. Or VA5Ck. Seasonally flooded temperate or subpolar grassland

*Rhynchospora* spp. - *Panicum* (*rigidulum*, *verrucosum*) - *Rhexia virginica*  
Seasonally Flooded Herbaceous Alliance

**Pond Shore Marsh**

Unknown / undefined Seasonally Flooded Herbaceous Alliance  
**Wet Meadow**

## Vegetation Key - Thomas Stone National Historic Site

Note: for each couplet, pick the best-fitting set of statements of the pair. Associations are listed by Latin name, common name, and synonym. Go  
to #:

**1a.** Uppermost vegetation layer is dominated by herbaceous vegetation, primarily grasses and grass-like plants.....**2**

**2a.** Vegetation never flooded; wetland species not a significant component of the flora. Vegetation dominated by exotic grasses.....**3**

**3a.** Vegetation dominated by tall (more than 20 cm tall), unmowed grasses. Tall, native grasses and forbs frequent and diverse.

***Festuca arundinacea* - *Dactylis glomerata* - *Apocynum cannabinum* Herbaceous Vegetation**  
**(Tall Fescue - Orchard Grass - Dogbane Herbaceous Vegetation)**  
**(Dry Meadow)**

**3b.** Vegetation mowed frequently and generally less than 20 cm tall. Native grasses and forbs restricted to a few species.

***Festuca arundinacea* - *Poa pratensis* - *Trifolium repens* Herbaceous Vegetation**  
**(Tall Fescue - Kentucky Bluegrass - Sweet Clover Herbaceous Vegetation)**  
**(Lawn)**

**2b.** Vegetation flooded as least a portion of year; wetland species are a significant component of the flora. Vegetation dominated by either exotic grasses or by native grasses and grass-like plants.....**4**

**4a.** Vegetation associated with a seasonally high water table (not with a pond). Vegetation comprised of a mixture of obligate wetland species and facultative or upland species.

***Dichanthelium clandestinum* Herbaceous Vegetation**  
**(Deer-tongue Grass Herbaceous Vegetation)**  
**(Wet Meadow)**

**4b.** Vegetation associated with a permanently high water table (situated at edge of a pond). Vegetation dominated by of obligate or near obligate wetland species.

***Panicum rigidulum* - *Juncus* spp. - *Rhexia virginica* Herbaceous Vegetation**  
**(Redtop Panic Grass - Rush - Virginia Meadow Beauty Herbaceous Vegetation)**  
**(Pond Shore Marsh)**

**1b.** Uppermost vegetation layer is dominated by full-sized or sapling trees.....**5**

**5a.** Shrubland, woodland or forest with uppermost layer dominated by small (sapling or pole-sized) trees. Canopy layer either mostly closed or partially open.....**6**

**6a.** Uppermost layer strongly dominated by sweet gum (*Liquidambar styraciflua*). Vegetation of uplands, slopes, or floodplains.

***Liquidambar styraciflua* Forest (Shrubland)**  
**(Sweet Gum Forest (Shrubland))**  
**(Early Successional Upland Sweet Gum Forest (Shrubland))**

**6a.** Uppermost layer dominated by river birch *Betula nigra*. Vegetation of depositional bars within channel of Hoghole Run.

***Betula nigra* Woodland**  
**(River Birch Woodland)**  
**(Depositional Bar)**

**5b.** Forest with uppermost layer dominated by large trees and canopy mostly closed.....**7**

**7a.** Obligate wetland species not a significant component of vegetation. Wetland hydrology not evident, except occasionally in small inclusions within stands. Vegetation of ravine slopes or upland flats.....**8**

**8a.** Neither tulip tree (*Liriodendron tulipifera*) nor sweet gum (*Liquidambar styraciflua*) a strong component of tree canopy (may be present as sapling-sized trees). Northern red oak (*Quercus rubra*) absent. Scarlet oak (*Quercus coccinea*) present. American hornbeam (*Carpinus caroliniana*), flowering dogwood (*Cornus florida*), and spicebush (*Lindera benzoin*) absent in shrub or subcanopy tree layers. Shrub layer dominated by ericaceous species (huckleberry (*Gaylussaccia baccata*), deerberry (*Vaccinium stamineum*), low blueberry (*V. pallidum*), mountain laurel (*Kalmia latifolia*)). Vegetation of upland flats with low slope.....**9**

**9a.** Virginia pine (*Pinus virginiana*) is leading dominant in canopy, with cover exceeding 50%. White oak (*Quercus alba*) is present at less than 25% cover. Most hardwoods reaching the tree layer (excluding isolated large trees) consist of mostly sapling to pole-sized trees (mostly less than 30 cm in diameter at breast height) that are mostly in the subcanopy. Saplings of sweet gum (*Liquidambar styraciflua*), bigtooth aspen (*Populus grandidentata*), pignut hickory (*Carya glabra*), and/or eastern red cedar (*Juniperus virginiana*) frequent.

***Pinus virginiana* - *Quercus* (*alba*, *stellata*, *coccinea*, *falcata*, *velutina*) -  
*Liquidambar styraciflua* Forest  
(Virginia Pine - Mixed Oak - Sweet Gum Forest )  
(Pine-Oak Forest)**

**9b.** Virginia pine (*Pinus virginiana*) not dominant in canopy (less than 30% cover), and, if present, scattered among hardwoods of equal or greater height. Most hardwoods reaching the canopy are of mature full-sized trees (mostly greater than 30 cm in diameter at breast height). Saplings of sweet gum (*Liquidambar styraciflua*), bigtooth aspen (*Populus grandidentata*), pignut hickory (*Carya glabra*), and/or eastern red cedar (*Juniperus virginiana*)  
rare.....**10**

**10a.** Scarlet Oak (*Quercus coccinea*) and Virginia pine (*Pinus virginiana*) frequent to codominant and, combined, account for at least 10% cover in canopy. Black gum (*Nyssa sylvatica*) is present at more than 5% cover in subcanopy and is [usually] the most frequent subcanopy species. Ericaceous shrubs (primarily huckleberry (*Gaylussacia baccata*) and/or mountain laurel (*Kalmia latifolia*)) strongly dominant in shrub layer (more than 20% cover). Herbaceous layer extremely depauperate and dominated by seedlings of trees or shrubs.

***Quercus alba* - *Quercus coccinea* / *Gaylussacia baccata* Forest  
(White Oak - Scarlet Oak / Black Huckleberry Forest)  
(Oak-Heath Forest)**

**10b.** Scarlet Oak (*Quercus coccinea*) and Virginia pine (*Pinus virginiana*), often present, but, combined, account for less than 10% cover in canopy. Black gum (*Nyssa sylvatica*) frequent, but less than 5% cover in subcanopy. Ericaceous shrubs (primarily huckleberry (*Gaylussacia baccata*) and/or low blueberry (*Vaccinium pallidum*)) frequent in shrub layer (less than 5% cover). Herbaceous layer is of low cover (0.5-2%), with herbaceous species (primarily sedges (*Carex* spp.)) frequent.

***Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest  
(White Oak - Beech / Low Blueberry Forest)  
(Dry Oak-Beech Forest)**

**8b.** Tulip Tree (*Liriodendron tulipifera*) and/or sweet gum (*Liquidambar styraciflua*) frequent in tree canopy. Scarlet oak (*Quercus coccinea*) absent. Northern red oak (*Quercus rubra*) present or absent. At least one of the three: Hornbeam (*Carpinus caroliniana*), flowering dogwood (*Cornus florida*), and spicebush (*Lindera benzoin*) present in shrub or subcanopy tree layers. Ericaceous shrubs absent from shrub layer, or if present, not dominant. Vegetation of ravine slopes and small stream bottoms.....**11**

**11a.** White oak (*Quercus alba*) frequent to codominant (more than 5% cover). Beech (*Fagus grandifolia*) codominant in tree layer and more than 25% cover. Mockernut hickory (*Carya alba*) frequent in canopy (more than 5% cover). Spicebush (*Lindera benzoin*) absent from shrub layer (may be present as seedlings); ferns rare except for Christmas fern (*Polystichum acrostichoides*). Lowbush blueberry (*Vaccinium pallidum*) present (at low cover). Enchanter's nightshade (*Circaea lutetiana*) absent.

***Fagus grandifolia* - *Quercus rubra* - *Quercus alba* / *Carpinus caroliniana* Forest  
(Beech - Red Oak - White Oak / American Hornbeam Forest)  
(Dry Mesic Forest)**

**11b.** White oak (*Quercus alba*) absent or rare (less than 5% cover). If present, beech (*Fagus grandifolia*) not codominant in tree layer and less than 10% cover. Mockernut hickory (*Carya alba*) rare to absent in canopy. Spicebush (*Lindera benzoin*) frequent to abundant (more than 5% cover) in shrub layer; ferns, usually of several species, frequent. Low blueberry (*Vaccinium pallidum*) absent. Enchanter's nightshade (*Circaea lutetiana*) present and usually frequent.....**12**

**12a.** Canopy strongly dominated by tulip tree (*Liriodendron tulipifera*). Red maple (*Acer rubrum*) is present at 10% in subcanopy. Flowering dogwood (*Cornus florida*) frequent (usually at more than 5% cover) in subcanopy or tall shrub layer. New York fern (*Thelypteris noveboracensis*) absent or rare. Vegetation of ravine slopes.

***Liriodendron tulipifera* / *Lindera benzoin* Forest  
(Tulip Tree / Spicebush Forest)  
(Tulip Tree Forest) (Mesic Forest)**

**12b.** Tulip tree (*Liriodendron tulipifera*) codominant in canopy with other species. Red maple (*Acer rubrum*) is present at more than 10% in subcanopy. Flowering dogwood (*Cornus florida*) usually absent, or if present, rare (less than 5% cover) to infrequent in subcanopy or tall shrub layer. New York fern (*Thelypteris noveboracensis*) frequent to abundant. Vegetation of ravine bottoms along small streams.

***Liriodendron tulipifera* - *Acer rubrum* - *Liquidambar styraciflua*/ *Thelypteris noveboracensis* Forest  
(Tulip Tree - Red Maple - Sweet Gum / New York Fern Forest)  
(Ravine Bottom Forest) (Wet Mesic Forest)**

**7b.** Obligate wetland species a significant component of vegetation. Vegetation of seepages, floodplains, small stream bottoms, or depressions in upland flats. Wetland hydrology (water standing or flowing at surface in dry weather, high water marks, gleyed or mottled soils, etc.)

evident.....  
13

**13a.** Vegetation situated along stream at or near bottom of a slope. Herbaceous layer fairly dense (more than 10% total cover) and diverse (more than 20 species/400 m<sup>2</sup>). False-nettle (*Boehmeria cylindrica*), American hornbeam (*Carpinus caroliniana*), spicebush (*Lindera benzoin*), and jack-in-the-pulpit (*Arisaema triphyllum*) present and sometimes frequent. Willow oak (*Quercus phellos*) present or not.....**14**

**14a.** At least two of the following seven species present: fringe tree (*Chionanthus virginicus*), sweetbay (*Magnolia virginiana*), water (*Oxypolis rigidior*), winterberry (*Ilex verticillata*), skunk cabbage (*Symplocarpus foetidus*), withrod (*Viburnum nudum*), prickly bog sedge (*Carex atlantica*). Vegetation of seepages from upland slopes, with surface water more or less continuously present and soil surface permanently saturated. Soil comprised of a combination of muck and gravelly sand, without discernible layering.

**Red Maple - Black Gum - Sweetbay Forest**  
(*Acer rubrum* - *Nyssa sylvatica* - *Magnolia virginiana* Forest)  
(Seepage Swamp) (Coastal Plain Seepage Swamp)

**14b.** No more than one of the following seven species present: (*Chionanthus virginicus*), sweetbay (*Magnolia virginiana*), water (*Oxypolis rigidior*), winterberry (*Ilex verticillata*), skunk cabbage (*Symplocarpus foetidus*), withrod (*Viburnum nudum*), prickly bog sedge (*Carex atlantica*). Soil surface flooded only by overbank flow from streams or by major precipitation events. Soil surface not permanently saturated. Soil comprised of clay loams, silt loams, or sandy loams (sometimes with gravel), with a darker upper organic/mineral horizon evident (may be narrow).....**15**

**15a.** Obligate or near-obligate wetland species (especially false-nettle (*Boehmeria cylindrica*), wood-reed (*Cinna arundinacea*), manna grass (*Glyceria striata*, blunt broom sedge (*Carex tribuloides*), greater bladder sedge (*Carex intumescens*), and fringed sedge (*Carex crinita*)), frequent throughout stand. River birch (*Betula nigra*) and/or pin oak (*Quercus palustris*) present. Beech (*Fagus grandifolia*) absent in shrub, subcanopy, and canopy. Pawpaw (*Asimina triloba*) rare (less than 5% cover) in shrub layer. Vegetation primarily of Hoghole Run floodplain.

**Liquidambar styraciflua - Quercus palustris / Cinna arundinacea Forest**  
(Sweet Gum - Pin Oak / Woodreed Forest)  
(Floodplain Swamp Forest)

**15b.** Obligate or near-obligate wetland species, when present, confined to small, poorly drained depressions within larger matrix of stand. River birch (*Betula nigra*) and/or pin oak (*Quercus palustris*) present. Beech (*Fagus grandifolia*) present in shrub, subcanopy, or canopy. Pawpaw (*Asimina triloba*) frequent (more

than 5% cover) in shrub layer. Vegetation primarily of small ravine bottoms along tributaries of Hoghole Run and occasionally along higher parts of floodplain or terraces along Hoghole Run.

***Liriodendron tulipifera* - *Acer rubrum* - *Liquidambar styraciflua* / *Thelypteris noveboracensis* Forest**

(Tulip Tree - Red Maple - Sweet Gum / New York Fern Forest )

**(Ravine Bottom Forest) (Wet Mesic Forest)**

**13b.** Vegetation situated in depression in upland flat and associated with a seasonal pool. Herbaceous layer very sparse (less than 3% total cover) and depauperate (fewer than 15 species/400 m<sup>2</sup>). False-nettle (*Boehmeria cylindrica*), American hornbeam (*Carpinus caroliniana*), spicebush (*Lindera benzoin*), and jack-in-the-pulpit (*Arisaema triphyllum*) absent. Willow oak (*Quercus phellos*) present.

***Liquidambar styraciflua* - *Acer rubrum* - *Quercus phellos* Forest**

**(Sweet Gum - Red Maple - Willow Oak Forest)**

**(Upland Depression Swamp)**



## **Vegetation Descriptions - Thomas Stone National Historic Site**

***Quercus alba* - *Quercus coccinea* / *Gaylussacia baccata* Forest**

COMMON NAME	White Oak - Scarlet Oak / Huckleberry forest
SYNONYM	Oak-Heath Forest
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	I. Forest
PHYSIOGNOMIC SUBCLASS	IB. Deciduous forest
PHYSIOGNOMIC GROUP	IB2. Cold-deciduous forest
PHYSIOGNOMIC SUBGROUP	IB2N. Natural/Semi-Natural cold-deciduous forest
FORMATION	IB2Na. Lowland or submontane cold-deciduous forest
ALLIANCE	IB2Na29. <i>Quercus alba</i> - <i>Quercus (falcata, stellata)</i> Forest Alliance

CLASSIFICATION CONFIDENCE LEVEL 3

RANGE (alliance)

The *Quercus alba* - *Quercus (falcata, stellata)* Forest Alliance is widely distributed across the southeastern United States, occurring north to at least New Jersey and Maryland (NatureServe Explorer 2001). In the mid-Atlantic states, it occurs on the Coastal Plain and Piedmont and in the low mountains. It often occurs on soils with fragipans.

ENVIRONMENTAL DESCRIPTION

At Thomas Stone NHS, this forest association occurs on interfluvial upland areas of low slope (generally less than 3%), generally above 46 meters (150 feet) in elevation, on sites that have a slightly convex exposure slope, and which have not been extensively cleared of forest in recent decades (i.e., probably at least 60 years old). The soil surface is nearly 100% covered with leaf litter, with a 2-4 cm thick red-brown (evidently more) humus layer. Soils are silt loams, evidently ultisols, are yellow-orange in the B horizon, and usually have a fragipan, the top of which is from about 5 to more than 25 cm below the soil surface. Soil pH was measured to be from 4.1 to 4.5. Areas in which stands of this type occur are mapped mostly as Beltsville silt loam, with some areas mapped as Exum silt loam (Hall and Mathews 1974).

USFWS WETLAND SYSTEM Not applicable

MOST ABUNDANT SPECIES

Thomas Stone NHS

<u>Stratum</u>	<u>Species</u>
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Tree canopy	<i>Quercus alba</i> , <i>Quercus coccinea</i> , <i>Quercus velutina</i> , <i>Pinus virginiana</i>
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Subcanopy     *Fagus grandifolia*, *Acer rubrum*, *Nyssa sylvatica*, *Sassafras albidum*  
Tall shrub     *Gaylussacia baccata*, *Kalmia latifolia*, *Vaccinium stamineum*, *Ilex opaca*  
Herbaceous     (sparse)

DIAGNOSTIC SPECIES *Kalmia latifolia*, *Vaccinium stamineum*, *Gaylussacia baccata*,  
*Quercus coccinea*

OTHER CHARACTERISTIC SPECIES *Chimaphila maculata*, *Smilax rotundifolia*, *Smilax glauca*, *Vaccinium pallidum*, *Amelanchier arborea*, *Rhododendron periclymenoides*,  
*Cypripedium acaule*

## VEGETATION DESCRIPTION

Globally (from NatureServe Explorer 2001)

Rangewide, the *Quercus alba* - *Quercus (falcata, stellata)* Forest Alliance is usually dominated by a mixture of white (*Quercus alba*) and southern red (*Q. falcata*) oaks, with post oak (*Q. stellata*) dominant or codominant. Scarlet (*Quercus coccinea*), black (*Q. velutina*), and blackjack (*Q. marilandica*) oaks, mockernut (*Carya alba*), pignut (*C. glabra*), sand (*C. pallida*), southern shagbark (*C. carolinae-septentrionalis*), and northern shagbark (*C. ovata*) hickories, and white ash (*Fraxinus americana*) are often present. Common subcanopy and shrub species include sourwood (*Oxydendrum arboreum*), red maple (*Acer rubrum*), winged elm (*Ulmus alata*), eastern red cedar (*Juniperus virginiana*), sassafras (*Sassafras albidum*), Blueberries (*Vaccinium arboreum*, *V. pallidum*, *V. stamineum*), and huckleberries (*Gaylussacia baccata*, *G. frondosa*). The herbaceous layer can include striped wintergreen (*Chimaphila maculata*), Christmas fern (*Polystichum acrostichoides*), ebony spleenwort (*Asplenium platyneuron*), arrow-leaved heartleaf (*Hexastylis arifolia*), greater tickseed (*Coreopsis major*), Virginia goat's-rue (*Tephrosia virginiana*), Maryland sanicle (*Sanicula canadensis*), naked-flowered tick-trefoil (*Desmodium nudiflorum*) Nuttall's tick-trefoil (*D. nuttallii*), arrow-leaved aster (*Aster sagittifolius*) late purple aster (*A. patens*), elm-leaved goldenrod (*Solidago ulmifolia*), and rattlesnake weed (*Hieracium venosum*).

### *Thomas Stone NHS*

In Thomas Stone NHS this forest association is characterized by a dominance in the canopy of oaks typical of dry acidic forests, with white oak (*Quercus alba*) and scarlet oak (*Q. coccinea*) the leading dominants, and black oak (*Q. velutina*) and southern red oak (*Q. falcata*) usually present. Beech (*Fagus grandifolia*) is frequent in the canopy or subcanopy, but not codominant. Scattered mature Virginia pines (*Pinus virginiana*) are frequent in the canopy. Black gum (*Nyssa sylvatica*) is generally the most abundant subcanopy species, with red maple (*Acer rubrum*) and American holly (*Ilex opaca*) also important. The shrub layer is characterized by a usually high cover of ericaceous shrubs, with either black huckleberry (*Gaylussacia baccata*), mountain laurel (*Kalmia latifolia*), or both strongly dominant, and deerberry (*Vaccinium stamineum*) usually present. Other small trees, shrubs, or vines that are typically present at low cover are sassafras (*Sassafras albidum*), serviceberry (*Amelanchier arborea*), pink azalea (*Rhododendron periclymenoides*), and greenbriers (*Smilax glauca* and *S. rotundifolia*). The herbaceous layer is very depauperate and is comprised primarily of striped wintergreen (*Chimaphila maculata*) and seedlings of several woody species.

The *Quercus alba* - *Quercus coccinea* / *Gaylussacia baccata* Forest is distinguished from the *Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest at Thomas Stone NHS more by relative contributions of species than by presence or absence of strongly diagnostic species. The *Quercus alba* - *Quercus coccinea* / *Gaylussacia baccata* Forest is more evenly dominated in the tree layers by species other than white oak (*Quercus alba*) and beech (*Fagus grandifolia*), has black gum (*Nyssa sylvatica*) as the most frequent subcanopy tree, and is strongly dominated in the shrub layer by black huckleberry (*Gaylussacia baccata*), mountain laurel (*Kalmia latifolia*), or both. The herbaceous layer of this forest is more depauperate than that of the *Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest.

The *Quercus alba* - *Quercus coccinea* / *Gaylussacia baccata* Forest is distinguished from the *Pinus virginiana* - *Quercus (alba, coccinea, falcata)*- *Liquidambar styraciflua* Forest by the position of Virginia Pine (*Pinus virginiana*) as an occasional canopy tree, rather than a leading or codominant canopy species, and by the prevalence of mature, rather than pole-sized, trees among the largest individual hardwoods in the tree layers.

NOTEWORTHY SPECIES None noted.

CONSERVATION RANK Unknown

#### RANK JUSTIFICATION

Further information is needed to define the range and extent of this association range and the corresponding rank.

#### COMMENTS

This type would likely be included in the Mixed Oak / Heath Forests of Fleming et al. (2001).

This type is evidently included in the concept of the Oak-Hickory Association of the Western Shore District of Shreve et al. (1910).

This type is similar or equivalent to the mixed oak forest of southern New Jersey of Collins and Anderson (1994).

The alliance assignment of this forest is somewhat difficult, but it appears to fit the *Quercus velutina* - *Quercus alba* (*Quercus coccinea*) Forest Alliance, better than the *Quercus alba* - *Quercus (falcata, stellata)* Forest Alliance for several reasons. The former alliance seems to include forests with a more northern or more Piedmont/montane elements, but the compositional descriptions of alliance and associations fit the Thomas Stone NHS forests somewhat better (the Inner Coastal Plain forests of Maryland tend to be floristically more similar to Piedmont vegetation than to Outer Coastal Plain vegetation). The former alliance places greater emphasis on *Quercus coccinea*, *Nyssa sylvatica*, and pines (which are characteristic at Thomas Stone NHS) and less emphasis on *Q. falcata* (present in the Thomas Stone NHS stands, but usually the fourth most important oak) and *Q. stellata* (probably present, but unimportant). The description of the latter alliance specifies that some examples occur over hardpans (fragipans), which is the case for this type at Thomas Stone NHS. Overall, this type is interpreted as belonging to the former alliance, based on overall composition, but is transitional to/has elements of the latter (e.g., absence of *Q. prinus* and *Q. rubra* and presence of *Q. falcata*).

This type intergrades with the *Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest at Thomas Stone NHS, and distinguishing the two types in the field can sometimes be difficult. Segregation of these is suggested by alliance delineations within the NVCS (NatureServe Explorer 2001), with the *Quercus alba* - *Quercus coccinea* / *Gaylussacia baccata* Forest seeming to follow the concept of the *Quercus alba* - *Quercus (falcata, stellata)* Forest Alliance, based, in part, on the absence of Piedmont elements such as *Quercus rubra* and *Quercus prinus* and the presence of *Quercus falcata*. The *Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest may be consistent with the concept of the *Quercus velutina* - *Quercus alba* (*Quercus coccinea*) Forest Alliance. Further review of the taxonomy at several levels is needed to confidently place these stands.

This type appears to be analogous and compositionally similar to the *Quercus (prinus, velutina)* / *Gaylussacia baccata* Forest described for Rock Creek Park (The Nature Conservancy 1998), with the main distinction being that *Q. prinus* is absent as an important canopy tree at Thomas Stone NHS, as it is in many dry forests throughout the Coastal Plain in Maryland.

#### PLOTS

431

501

602

***Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest**

COMMON NAME	White Oak - Beech / Low Blueberry Forest
SYNONYM	Dry Oak - Beech forest
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	I. Forest
PHYSIOGNOMIC SUBCLASS	IB. Deciduous forest
PHYSIOGNOMIC GROUP	IB2. Cold-deciduous forest
PHYSIOGNOMIC SUBGROUP	IB2N. Natural/Semi-Natural cold-deciduous forest
FORMATION	IB2Na. Lowland or submontane broad-leaved cold-deciduous forest
ALLIANCE	IB2Na16. <i>Fagus grandifolia</i> - <i>Quercus alba</i> Forest Alliance  IB2Na100. <i>Quercus velutina</i> - <i>Quercus alba</i> - ( <i>Quercus coccinea</i> ) Forest Alliance

**CLASSIFICATION CONFIDENCE LEVEL 3**

**RANGE (alliance)**

The *Quercus velutina* - *Quercus alba* - (*Quercus coccinea*) Forest Alliance is widely distributed throughout the eastern United States, occurring north to at least Maine (NatureServe Explorer 2001). In the mid-Atlantic states, it occurs on the Blue Ridge and Piedmont.

**ENVIRONMENTAL DESCRIPTION**

At Thomas Stone NHS, this forest association occurs on upland areas of low slope (generally less than 6%), generally above the 46 meter (150 feet) elevation, where slope shape is flat to slightly concave, and where the forest has not been extensively cleared in recent decades (i.e., stands are probably at least 60 years old and are often much older). The soil surface is nearly 100% covered with leaf litter, with a 1-5 cm thick brown to red-brown (evidently more) humus. Soils are silt loams, evidently ultisols, are yellow-orange in the B horizon with an ubiquitous fragipan, the top of which is from about 5 to 20 cm below the soil surface. Soil pH was measured to be from 4.3 to 4.9. Areas in which stands of this type occur are mapped mostly as Beltsville silt loam, with smaller areas mapped as Exum silt loam (Hall and Mathews 1974).

USFWS WETLAND SYSTEM      Not applicable.

**MOST ABUNDANT SPECIES**

*Thomas Stone NHS*

<u>Stratum</u>	<u>Species</u>
Canopy	<i>Quercus alba</i> , <i>Fagus grandifolia</i>
Subcanopy	<i>Acer rubrum</i> , <i>Nyssa sylvatica</i>
Shrub layer	<i>Vaccinium pallidum</i> , <i>Gaylussacia baccata</i> , <i>Ilex opaca</i>
Herbaceous	<i>Carex swanii</i> , <i>Carex albicans</i> var. <i>emmonsii</i> , <i>Chimaphila maculata</i> , <i>Smilax rotundifolia</i> , <i>Smilax glauca</i> , <i>Asimina triloba</i> *

\* - in this type, possibly invading due to selective browsing by deer

DIAGNOSTIC SPECIES *Vaccinium pallidum*, *Carex willdenowii*

OTHER CHARACTERISTIC SPECIES *Quercus velutina*, *Quercus falcata*, *Quercus coccinea*, *Carya alba*, *Danthonia spicata*, *Monotropa uniflora*, *Prunus serotina* (seedlings), *Tipularia discolor*

VEGETATION DESCRIPTION

*Globally* (adapted from The Nature Conservancy (1998) and Lea (2000))

Rangewide, this unit is co-dominated by oaks, including white (*Quercus alba*) (primarily), black (*Q. velutina*), northern red (*Q. rubra*), chestnut (*Q. prinus*) and/or scarlet (*Q. coccinea*). Beech (*Fagus grandifolia*) occurs as a canopy or subcanopy codominant, with red maple (*Acer rubrum*) and black gum (*Nyssa sylvatica*) also prevalent in the subcanopy. Hickories (*Carya* spp.) are frequently present and are more common in more recently disturbed stands. Tulip tree (*Liriodendron tulipifera*) and sweet gum (*Liquidambar styraciflua*) are rare or absent in mature stands. A sparse small tree/tall shrub layer, with flowering dogwood (*Cornus florida*) and American holly (*Ilex opaca*) is usually present. The short shrub layer is sparse and characterized by maple-leaved viburnum (*Viburnum acerifolium*); ericaceous shrubs may be present, with *Vaccinium pallidum* usually the most common species. Typical herbs include crane-fly orchid (*Tipularia discolor*), bellwort (*Uvularia* spp.), Virginia creeper (*Parthenocissus quinquefolia*), pink lady's slipper (*Cypripedium acaule*), Willdenow's sedge (*Carex willdenowii*), partridgeberry (*Mitchella repens*), striped wintergreen (*Chimaphila maculata*) and Indian pipes (*Monotropa uniflora*). The herb layer is never lush, but is less depauperate than are typical acidic oak-heath forests.

*Thomas Stone NHS*

In Thomas Stone NHS, this forest is dominated (often strongly so) by white oak (*Quercus alba*) in the canopy, with beech (*Fagus grandifolia*) codominant or prominent in the canopy and subcanopy. Canopy associates include other oak species of dry woods, primarily black (*Quercus velutina*), scarlet (*Q. coccinea*), and southern red (*Q. falcata*). Red maple (*Acer rubrum*) and black gum (*Nyssa sylvatica*) are usually codominant in the subcanopy, with mockernut hickory (*Carya alba*) often present, but at low cover. Tulip tree (*Liriodendron tulipifera*) and sweet gum (*Liquidambar styraciflua*) are essentially absent. The tall shrub layer is generally sparse with American holly (*Ilex opaca*) frequently present, and downy serviceberry (*Amelanchier arborea*) occasionally present. Flowering dogwood (*Cornus florida*) is rare to absent. The low shrub layer is better developed and is dominated by ericaceous shrubs, primarily by low blueberry (*Vaccinium pallidum*), with black huckleberry (*Gaylussacia baccata*) often frequent. The

herbaceous layer is generally sparse and of low species richness, with several sedges (*Carex swanii*, *C. willdenowii*, and *C. albicans* var. *emmonsii*) usually the most frequent species. Striped wintergreen (*Chimaphila maculata*), Indian pipes (*Monotropa uniflora*), poverty grass (*Danthonia spicata*), pink lady's-slipper (*Cypripedium acaule*), and seedlings of greenbriers (*Smilax glauca*, *S. rotundifolia*), Virginia creeper (*Parthenocissus quinquefolia*), and several tree species are also typically present. *Asimina triloba* seedlings are frequently established in this forest as seedlings and may increase in importance with time. The presence and rapid increase of this species of mesic forests in this dry forest type may reflect heavy selective browse pressure by white-tailed deer.

Stands of the *Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest are distinguished from the *Quercus alba* - *Quercus coccinea* / *Gaylussacia baccata* Forest at Thomas Stone NHS more by relative contributions of species than by presence or absence of strongly diagnostic species. The *Fagus grandifolia* - *Quercus alba* Forest is more strongly dominated by greater dominance of white oak (*Quercus alba*) and beech (*Fagus grandifolia*) in the canopy and subcanopy, a lesser dominance of ericaceous shrubs, and a greater abundance and species richness of herbaceous species. The dominance of mountain laurel (*Kalmia latifolia*) and/or black huckleberry (*Gaylussacia baccata*) in the shrub layer is generally indicative of the *Quercus alba* - *Quercus coccinea* / *Gaylussacia baccata* Forest, whereas the *Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest generally has low blueberry (*Vaccinium pallidum*) as the most frequent ericaceous shrub.

The *Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest is distinguished from the *Fagus grandifolia* - *Quercus rubra* - *Quercus alba* / *Carpinus caroliniana* Forest by (1) a lower richness of herbaceous species, (2) a greater prevalence of ericaceous species in the shrub layer, (3) the presence of species of acidic forests (particularly scarlet oak (*Quercus coccinea*) and black huckleberry (*Gaylussacia baccata*)), (4) the absence of more mesic species, including northern red oak (*Quercus rubra*), tulip tree (*Liriodendron tulipifera*), American hornbeam (*Carpinus caroliniana*), and Christmas fern (*Polystichum acrostichoides*), and (5) its position on higher, relatively level, land, rather than on ravine slopes.

The *Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest is distinguished from the *Pinus virginiana* - *Quercus* (*alba*, *coccinea*, *falcata*)- *Liquidambar styraciflua* Forest by (1) the absence of Virginia pine (*Pinus virginiana*) as a canopy dominant, (2) the prevalence of mature, rather than pole-sized, trees among the largest individual hardwoods in the tree layers, and (3) the rarity or absence of early successional [on dry uplands] species, such as sweet gum (*Liquidambar styraciflua*), bigtooth aspen (*Populus grandidentata*), and eastern red cedar (*Juniperus virginiana*).

NOTEWORTHY SPECIES None noted.

CONSERVATION RANK Unknown

#### RANK JUSTIFICATION

The assignment of this association within the NVCS must be determined before a tentative rank is assigned. The association is not likely to be uncommon or rare.



## COMMENTS

This association is difficult to distinguish from the *Quercus alba* - *Quercus coccinea* / *Gaylussacia baccata* Forest in some situations, but comparison of Thomas Stone NHS data with NVCS alliance descriptions suggests that segregation into two types may be warranted. The *Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest appears to be equivalent or identical to the Mixed Oak - Beech variant of the *Fagus grandifolia* - *Quercus alba* / *Podophyllum peltatum* Forest (*Fagus grandifolia* - *Quercus alba* Forest Alliance) of Rock Creek Park (The Nature Conservancy 1998) and the *Quercus alba* - *Fagus grandifolia* - *Acer rubrum* / *Chimaphila maculata* Forest of the Potomac River Gorge (Lea 2000), both of which were described from the nearby Piedmont. *Quercus rubra* and *Q. prinus* are often present (but usually infrequent) in the Piedmont stands, but are absent from the *Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest at Thomas Stone NHS.

Acidic forests in the Outer Piedmont / Inner Coastal Plain of this region that have *Quercus alba* and *Fagus grandifolia* strongly dominant in the canopy probably need recognition. Their assignment within NVCS is problematic in that the canopy dominants place them in the dry-mesic *Fagus grandifolia* - *Quercus alba* Forest Alliance, but much of the rest of the flora tends to be similar to alliances that include acidic oak forests.

This association might be included in the concept of Piedmont / Coastal Plain Oak - Beech / Heath Forests (ecological group) in the state classification for Virginia (Fleming et al. 2001). Other than the frequency of *Fagus grandifolia* and the relatively minor importance of *Carya* spp., it also resembles the Acidic Oak - Hickory Forests of the Virginia classification.

This association is evidently included in the concept of the Oak-Hickory Association of the Western Shore District of Shreve et al. (1910).

This association is similar or equivalent to the mixed oak forest of southern New Jersey of Collins and Anderson (1994).

## PLOTS

131

402

412 (transitional to *Quercus alba* - *Quercus coccinea* / *Gaylussacia baccata* Forest)

422 (transitional to *Fagus grandifolia* - *Quercus rubra* - *Quercus alba* / *Carpinus caroliniana* Forest)

***Pinus virginiana* - *Quercus* (*alba*, *stellata*, *coccinea*, *falcata*, *velutina*)- *Liquidambar styraciflua* Forest**

COMMON NAME	Virginia Pine - Mixed Oak - Sweet Gum forest
SYNONYM	Pine-Oak (dry) Forest
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	I. Forest
PHYSIOGNOMIC SUBCLASS	IC. Mixed evergreen-deciduous forest
PHYSIOGNOMIC GROUP	IC3. Mixed needle-leaved evergreen-cold-deciduous Forest
PHYSIOGNOMIC SUBGROUP	IC3N. Natural/Semi-Natural mixed needle-leaved evergreen- cold-deciduous forest
FORMATION	IC3Na. Mixed needle-leaved evergreen-cold-deciduous forest
ALLIANCE	IC3Na27. <i>Pinus virginiana-Quercus</i> ( <i>alba</i> , <i>stellata</i> , <i>falcata</i> , <i>velutina</i> ) Forest Alliance

**CLASSIFICATION CONFIDENCE LEVEL 1**

**RANGE (alliance)**

The *Pinus virginiana-Quercus* (*alba*, *stellata*, *falcata*, *velutina*) Forest Alliance is known to occur in New Jersey, Maryland, and Delaware (NatureServe Explorer 2001). It is undoubtedly more widespread in the mid-Atlantic and southeastern United States, depending upon the application of the alliance.

**ENVIRONMENTAL DESCRIPTION**

At Thomas Stone NHS, this forest association occurs on upland areas of low slope (generally less than 3%), generally above the 46 meter (150 feet) elevation, on slopes that are flat to slightly concave, which have been extensively cleared in recent decades (evidently less than 60 years ago). Stands at lower elevations were not observed, but may exist on convex ravine slopes with south to west-facing exposures. The soil surface is nearly 100% covered with leaf litter, with a 0.5-2 cm thick brown humus. A fragipan is consistently present, with its top usually from about 5 to 20 cm below the soil surface. Soils are silt loams, evidently ultisols, but with poor horizon development evident above the fragipan (possibly due to past plowing). Soil pH was measured to be from 4.1 to 4.9. Areas in which stands of this type occur are mapped mostly as Beltsville silt loam, with smaller areas mapped as Exum silt loam (Hall and Mathews 1974).

USFWS WETLAND SYSTEM	Not applicable
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## MOST ABUNDANT SPECIES

Thomas Stone NHS

<u>Stratum</u>	<u>Species</u>
Canopy	<i>Pinus virginiana</i>
Subcanopy	<i>Acer rubrum</i> , <i>Quercus velutina</i> , <i>Q. coccinea</i> , <i>Q. alba</i> , <i>Liquidambar styraciflua</i> , <i>Carya glabra</i> , <i>Nyssa sylvatica</i>
Shrub	<i>Fagus grandifolia</i> , <i>Ilex opaca</i> , <i>Gaylussacia baccata</i> , <i>Vaccinium stamineum</i> , <i>V. pallidum</i>
Herbaceous	<i>Carex swanii</i> , <i>Mitchella repens</i> , <i>Uvularia sessilifolia</i>

DIAGNOSTIC SPECIES     *Pinus virginiana*, *Populus grandidentata*, *Carya glabra*

OTHER CHARACTERISTIC SPECIES *Quercus stellata*, *Juniperus virginiana*, *Danthonia spicata*, *Prunus serotina*, *Carex willdenowii*, *Chimaphila maculata*, *Smilax glauca*, *S. rotundifolia*

## VEGETATION DESCRIPTION

Globally (adapted from The Nature Conservancy 1998 and NatureServe Explorer 2001)

The *Pinus virginiana* - *Quercus* (*alba*, *stellata*, *falcata*, *velutina*) Forest Alliance includes mixed evergreen/deciduous canopies composed primarily of Virginia pine (*Pinus virginiana*), with various mixtures of oaks (*Quercus alba*, *Q. stellata*, *Q. falcata*, *Q. velutina*). Over time these areas succeed to hardwood forests dominated by oaks, oaks and beech (*Fagus grandifolia*), or oaks, beech and tulip tree (*Liriodendron tulipifera*).

Thomas Stone NHS

The *Pinus virginiana* - *Quercus* (*alba*, *stellata*, *coccinea*, *falcata*, *velutina*)- *Liquidambar styraciflua* Forest is an early successional vegetation type which would be expected to succeed to the *Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest. The precursor to the *Quercus alba* - *Quercus coccinea* / *Gaylussacia baccata* Forest may also be this type. It is characterized by a tree layer co-dominated by mature Virginia Pine (*Pinus virginiana*) and young (pole-sized to early mature) and dense hardwoods, primarily oaks. The tree layer may have Virginia pine (*Pinus virginiana*) dominating the canopy above a subcanopy of hardwoods or may be poorly stratified. The hardwood component of the tree layer is diverse and includes white (*Quercus alba*), black (*Q. velutina*), scarlet (*Q. coccinea*) and southern red (*Q. falcata*) oaks, pignut (*Carya glabra*) and mockernut (*C. alba*) hickories, and other species of the more mature dry forests, such as red maple (*Acer rubrum*) and black gum (*Nyssa sylvatica*). Shade-intolerant species that are rare to absent in the mature dry forests, including sweet gum (*Liquidambar styraciflua*), bigtooth aspen (*Populus grandidentata*), and tulip tree (*Liriodendron tulipifera*), are present in the tree layer at low cover. The tall shrub layer is somewhat confluent with the tree layer and is often strongly dominated by beech (*Fagus grandifolia*), with American holly (*Ilex opaca*) frequent. The short shrub layer is a poorly developed and comprised of ericaceous shrubs, including black huckleberry (*Gaylussacia baccata*) low blueberry (*Vaccinium pallidum*), and deerberry (*V. stamineum*). The herbaceous layer has low cover and is comprised of species also characteristic of the *Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest.

The *Pinus virginiana* - *Quercus* (*alba*, *coccinea*, *falcata*)- *Liquidambar styraciflua* Forest is distinguished from the *Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest and the *Quercus alba* - *Quercus coccinea* / *Gaylussacia baccata* Forest associations by (1) the position of Virginia pine (*Pinus virginiana*) as a canopy dominant or codominant, (2) the prevalence of predominantly small (pole-sized) trees among the largest hardwoods in the tree layers, and (3) the frequency (all species) of early successional [on dry uplands] species, such as sweet gum (*Liquidambar styraciflua*), bigtooth aspen (*Populus grandidentata*), post oak (*Quercus stellata*), and tulip tree (*Liriodendron tulipifera*).

NOTEWORTHY SPECIES    None noted.

CONSERVATION RANK    GW

RANK JUSTIFICATION    This is a successional forest type.

#### COMMENTS

Vegetation that is approximately equivalent to this type is also found in Rock Creek Park in the Piedmont (The Nature Conservancy 1998), with sweet gum (*Liquidambar styraciflua*) evidently absent at Rock Creek Park. *L. styraciflua* was included as a nominal for the association as expressed at Thomas Stone NHS and perhaps elsewhere on the Coastal Plain, but this distinction may not warrant segregation of this vegetation into two associations.

Stands of vegetation corresponding to the *Pinus virginiana* Forest of the NVCS (i.e., forests strongly dominated by *P. virginiana* and without a significant hardwood component) also occur at Thomas Stone NHS and are more extensive just outside the park. Because they are extremely small within Thomas Stone NHS, such stands within the park have been included in the concept of the mixed hardwood-pine type as described here.

This type is evidently included in the concept of the Pine-Oak Association of the Western Shore District of Shreve et al. (1910).

This type is similar or equivalent to the Virginia pine successional forest of southern New Jersey of Collins and Anderson (1994).

#### PLOTS

201

211

601 (transitional to *Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest)

***Fagus grandifolia* - *Quercus rubra* - *Quercus alba* / *Carpinus caroliniana* Forest**

COMMON NAME	Beech - Northern Red Oak - White Oak / American Hornbeam Forest
SYNONYM	Dry Mesic Forest
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	I. Forest
PHYSIOGNOMIC SUBCLASS	IB. Deciduous forest
PHYSIOGNOMIC GROUP	IB2. Cold-deciduous forest
PHYSIOGNOMIC SUBGROUP	IB2N. Natural/Semi-natural cold-deciduous forest
FORMATION	IB2Na. Lowland or submontane broad-leaved cold-deciduous forest
ALLIANCE	IB2Na17. <i>Fagus grandifolia</i> - <i>Quercus rubra</i> - <i>Quercus alba</i> Forest Alliance

CLASSIFICATION CONFIDENCE LEVEL 2 (see comments)

**RANGE (alliance)**

The *Fagus grandifolia* - *Quercus rubra* - *Quercus alba* Forest Alliance occurs in non-montane or low mountain areas throughout the mid-Atlantic and southeastern United States. In the mid-Atlantic states, it should occur in the low Appalachian Mountains and Piedmont.

**ENVIRONMENTAL DESCRIPTION** At Thomas Stone NHS, this forest association occurs on convex to flat shaped, moderately steep (5-15%) slopes of ravines, generally below 46 meters (150 feet) in elevation. Stands are apparently relatively old and usually show no signs of no recent (i.e., within the previous 60 years) extensive clearing. In some stands, more recent selective cutting may be evident. The soil surface is approximately 95% covered with leaf litter, with bare soil patches frequent. The humus layer is typically very thin (0-1 cm) and brown. Soils were found in the field to be gravelly loams or gravelly sandy loams, probably ultisols, and are very stony, with frequent rounded gravel particles up to 2 cm in diameter. Soil pH was measured to be from 4.3 to 4.9. Areas in which stands of this type occur are mapped almost exclusively as Aura gravelly sandy loam.

USFWS WETLAND SYSTEM Not applicable.

**MOST ABUNDANT SPECIES**

*Thomas Stone NHS*

Stratum

Species

Tree canopy	<i>Fagus grandifolia</i> , <i>Quercus alba</i> , <i>Liquidambar styraciflua</i> , <i>Carya alba</i> , <i>Liriodendron tulipifera</i> , <i>Quercus rubra</i>
Subcanopy	<i>Acer rubrum</i> , <i>Nyssa sylvatica</i> , <i>Cornus florida</i> , <i>Asimina triloba</i>
Shrub	<i>Ilex opaca</i> , <i>Carpinus caroliniana</i> , <i>Asimina triloba</i> *, <i>Vaccinium pallidum</i>
Herbaceous	<i>Carex albicans</i> var. <i>albicans</i> , <i>Carex swanii</i> , <i>Carex digitalis</i> , <i>Polystichum acrostichoides</i> , <i>Goodyera pubescens</i> , <i>Smilax rotundifolia</i> , <i>Smilax glauca</i> , <i>Parthenocissus quinquefolia</i>

\* - the abundance, and perhaps the presence, of this species in this association may be due to invasion following selective browsing by deer

DIAGNOSTIC SPECIES *Quercus rubra*, *Carya alba*, *Goodyera pubescens*, *Carpinus caroliniana*, *Carex digitalis*, *Carex albicans* var. *albicans*

OTHER CHARACTERISTIC SPECIES *Carex laxiculmis*, *Uvularia sessilifolia*, *Mitchella repens*, *Euonymus americana*, *Symphotrichum divaricatum*, *Galium circaeans*, *Luzula echinata*, *Quercus velutina*, *Fraxinus americana*

## VEGETATION DESCRIPTION

Globally (adapted from NatureServe Explorer 2001)

The *Fagus grandifolia* - *Quercus rubra* - *Quercus alba* Forest Alliance is a dry-mesic to mesic forest dominated by beech (*Fagus grandifolia*), with or without some combination of northern red oak (*Quercus rubra*) and white oak (*Q. alba*). Associated canopy and subcanopy species include tulip tree (*Liriodendron tulipifera*), sugar maple (*Acer saccharum*), red maple (*A. rubrum*), umbrella magnolia (*Magnolia tripetala*), cucumber tree (*M. acuminata*), American basswood (*Tilia americana*), chinquapin oak (*Quercus muehlenbergii*), flowering dogwood (*Cornus florida*), hop hornbeam (*Ostrya virginiana*), buckeye (*Aesculus sylvatica*), and American holly (*Ilex opaca*). The shrub layer is characterized by deerberry (*Vaccinium stamineum*), downy arrowwood (*Viburnum rafinesquianum*), strawberry bush (*Euonymus americana*) and, sometimes, mountain laurel (*Kalmia latifolia*). Herbs include Christmas fern (*Polystichum acrostichoides*), wild licorice (*Galium circaeans*), heartleafs (*Hexastylis arifolia*, *H. minor*), naked-flowered tick-trefoil (*Desmodium nudiflorum*), southern yellow trout lily (*Erythronium umbilicatum*), blunt-lobed hepatica (*Hepatica nobilis* var. *obtusata*), beechdrops (*Epifagus virginiana*), foamflower (*Tiarella cordifolia*), alumroot (*Heuchera americana*), star chickweed (*Stellaria pubera*), mayapple (*Podophyllum peltatum*), and Virginia rattlesnake fern (*Botrychium virginianum*).

### Thomas Stone NHS

At Thomas Stone NHS, the *Fagus grandifolia* - *Quercus rubra* - *Quercus alba* / *Carpinus caroliniana* Forest is characterized by a relatively even mix of tree species in the canopy and subcanopy, including white oak (*Quercus alba*), beech (*Fagus grandifolia*), tulip tree (*Liriodendron tulipifera*), sweet gum (*Liquidambar styraciflua*), mockernut hickory (*Carya alba*), northern red oak (*Quercus rubra*), and, to a lesser extent, black oak (*Quercus velutina*) and white ash (*Fraxinus americana*). Frequent subcanopy species are red maple (*Acer rubrum*) and black gum (*Nyssa sylvatica*), with American hornbeam (*Carpinus caroliniana*), flowering dogwood (*Cornus florida*), and American holly (*Ilex opaca*) present as small trees or tall shrubs.

A greater abundance of tulip tree (*Liriodendron tulipifera*) and/or sweet gum (*Liquidambar styraciflua*) in the canopy is probably indicative of stands that have been disturbed more recently. Pawpaw (*Asimina triloba*) is often frequent as a short to tall shrub; its presence and/or abundance in this type may reflect recent invasion by this species in response to selective browsing by white-tailed deer. The herbaceous layer is of relatively low cover, but is moderately diverse, with several sedges (*Carex digitalis*, *C. swanii*, *C. albicans*), Christmas fern (*Polystichum acrostichoides*), rattlesnake plantain (*Goodyera pubescens*), Indian pipes (*Monotropa uniflora*), Jack-in-the-pulpit (*Arisaema triphyllum*), partridgeberry (*Mitchella repens*), bellwort (*Uvularia sessilifolia*), false Solomon's-seal (*Maianthemum racemosum*), and prickly wood-rush (*Luzula echinata*) frequent. Seedlings of Virginia creeper (*Parthenocissus quinquefolia*), greenbriers (*Smilax glauca*, *S. rotundifolia*), poison ivy (*Toxicodendron radicans*), and strawberry bush (*Euonymus americana*) are also characteristic.

At Thomas Stone NHS, the *Fagus grandifolia* - *Quercus rubra* - *Quercus alba* / *Carpinus caroliniana* Forest is distinguished from the *Liriodendron tulipifera* / *Lindera benzoin* Forest (drier versions of which may represent stands succeeding to the former type), by (1) the position of tulip tree (*Liriodendron tulipifera*) as a frequent or, at most, a codominant species in the canopy, rather than as a strongly leading dominant, (2) by the absence of spicebush (*Lindera benzoin*) as a significant component of the shrub layer, and (3) by the rarity or absence of calciphilic species.

The *Fagus grandifolia* - *Quercus rubra* - *Quercus alba* / *Carpinus caroliniana* Forest is distinguished from the *Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest by (1) a higher richness of herbaceous species, (2) a relatively low frequency to absence of ericaceous species in the shrub layer, (3) the absence of species restricted to acidic forests (particularly scarlet oak (*Quercus coccinea*) and black huckleberry (*Gaylussacia baccata*)), (4) the presence of more mesic species, including northern red oak (*Quercus rubra*), tulip tree (*Liriodendron tulipifera*), American hornbeam (*Carpinus caroliniana*), and Christmas fern (*Polystichum acrostichoides*), and (5) its position on ravine slopes, rather than on higher, relatively level, land.

#### NOTEWORTHY SPECIES

*Carex digitalis* var. *asymmetrica* is present and possibly frequent in this association at Thomas Stone NHS, which is currently the only known Maryland site and possibly the most northern known station for this taxon.

CONSERVATION RANK    Unknown

RANK JUSTIFICATION    Further information is needed to define the range and extent of this association range and the corresponding rank.

#### COMMENTS

This association would likely be included in the Mesic Mixed Hardwood Forests of Fleming et al. (2001).

This association is evidently included in the concept of the Oak-Hickory Association of the Western Shore District of Shreve et al. (1910).

This association is evidently analogous or identical to the "classic variant" of the *Fagus grandifolia* - *Quercus alba* / *Podophyllum peltatum* Forest of Rock Creek Park, an association that was placed within the *Fagus grandifolia* - *Quercus alba* Forest Alliance (The Nature Conservancy 1998). Both should probably be Stone NHS is placed within the *Fagus grandifolia* - *Quercus rubra* - *Quercus alba* Forest Alliance, since *Q. rubra* is characteristic at both locations and is diagnostic at Thomas Stone NHS. Though both alliances are comprised of relatively rich dry mesic forests, the *Fagus grandifolia* - *Quercus alba* Forest Alliance type is described generally as occurring on the Coastal Plain, where *Q. rubra* may be absent (NatureServe 2001). *Liquidambar styraciflua* is frequent in this association at Thomas Stone NHS but absent from the analogous vegetation in Rock Creek Park.

This type is similar or equivalent to the beech-oak forest of southern New Jersey of Collins and Anderson (1994).

#### PLOTS

301

311

322



***Liriodendron tulipifera* - *Acer rubrum* - *Liquidambar styraciflua* / *Thelypteris noveboracensis*  
Forest**

COMMON NAME	Tulip tree - Red maple - Sweet gum / New York Fern Forest
SYNONYM	Ravine Bottom (wet mesic) Forest
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	I. Forest
PHYSIOGNOMIC SUBCLASS	IB. Deciduous forest
PHYSIOGNOMIC GROUP	IB2. Cold-deciduous forest
PHYSIOGNOMIC SUBGROUP	IB2N. Natural/Semi-natural cold-deciduous forest
FORMATION	IB2Nd. Temporarily flooded cold-deciduous Forest
ALLIANCE	IB2Nd16. <i>Liquidambar styraciflua</i> - ( <i>Liriodendron tulipifera</i> , <i>Acer rubrum</i> ) Temporarily Flooded Forest Alliance or IB2Nd14. <i>Platanus occidentalis</i> - ( <i>Liquidambar styraciflua</i> , <i>Liriodendron tulipifera</i> ) Temporarily Flooded Forest Alliance

**CLASSIFICATION CONFIDENCE LEVEL 3**

**RANGE (alliances)**

The *Liquidambar styraciflua* - (*Liriodendron tulipifera*, *Acer rubrum*) Temporarily Flooded Forest

Alliance occurs in the lower Piedmont, Interior Low Plateau, Coastal Plain, and possibly the Cumberland Plateau, ranging into the Ouachita Mountains and Ozarks (NatureServe Explorer 2001).

The *Platanus occidentalis* - (*Liquidambar styraciflua*, *Liriodendron tulipifera*) Temporarily Flooded Forest Alliance is known from the southeastern United States, north to Virginia (NatureServe Explorer 2001).

As described here, this association occurs in Charles County, Maryland, where it has been described from the watersheds of Zekiah Swamp and Hoghole Run (Port Tobacco River drainage). It would be expected elsewhere on the inner Coastal Plain in Maryland and northern Virginia and possibly farther south.

## ENVIRONMENTAL DESCRIPTION

This association occurs at the bottom of ravines of small (first or second order) streams that are tributaries to Hoghole Run and also on higher, better-drained parts of the Hoghole Run floodplain or on adjacent lower slopes. Slope is generally low in the former situation, but can range up to 9% in the latter setting. The soil surface is mostly (95-98%) covered with a thin (up to 1 cm thick) layer of leaf litter. A humus layer is generally absent or, if present, very shallow. An upper mineral [A] horizon stained dark brown with organic matter varies from about 1-15 cm thick, and is thicker in drier situations. Gleying was consistently seen (in the mineral horizon) within 0-20 cm of the soil surface. Mottles were sometimes seen at a depth of 10-15 cm, but were not consistently evident. Soils were observed to be somewhat poorly drained to moderately well drained gravelly sandy loams or sandy clay loams. Soil pH was measured to be about 4.5 to 5.2. Areas in which stands of this type occurs are mapped mostly as Aura gravelly sandy loam, with some areas mapped as Croom gravelly loam or as Mattapex fine sandy loam.

Although it undoubtedly experiences at least rare overbank flow, "floodplains" of small streams receive much less frequent overbank flow than do those of higher order streams. This aspect of the hydrology of this forest is probably not as important as its position in a ravine bottom with a moderately high water table. These conditions evidently produce a generally mesic vegetation, with small patches of more hydric vegetation in seasonally flooded depressions.

USFWS WETLAND SYSTEM      Wetter parts of this forest association may be classified as Palustrine

## MOST ABUNDANT SPECIES

*Thomas Stone NHS*

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Liriodendron tulipifera</i> , <i>Liquidambar styraciflua</i>
Subcanopy	<i>Acer rubrum</i> , <i>Fagus grandifolia</i> , <i>Ilex opaca</i> , <i>Carpinus caroliniana</i> , <i>Ulmus americana</i>
Shrub	<i>Lindera benzoin</i> , <i>Asimina triloba</i>
Herbaceous	<i>Carex radiata</i> , <i>Thelypteris noveboracensis</i> , <i>Arisaema triphyllum</i> , <i>Athyrium filix-femina</i> , <i>Polystichum acrostichoides</i> , <i>Boehmeria cylindrica</i>

DIAGNOSTIC SPECIES *Liriodendron tulipifera*, *Thelypteris noveboracensis*, *Lycopodium obscurum*, *Carex radiata*

OTHER CHARACTERISTIC SPECIES *Platanus occidentalis*, *Carya cordiformis*, *Carex swanii*, *Leersia virginica*, *Festuca subverticillata*, *Quercus rubra*, *Lycopodium digitatum*, *Carex laxiculmis*, *Carex albolutescens*, *Sanicula canadensis*, *Muhlenbergia schreberi*

## VEGETATION DESCRIPTION

*Globally* (adapted from NatureServe Explorer 2001)

This *Liquidambar styraciflua* - (*Liriodendron tulipifera*, *Acer rubrum*) Temporarily Flooded Forest

Alliance is comprised of forests that are dominated by sweet gum (*Liquidambar styraciflua*) with or without some combination of tulip tree (*Liriodendron tulipifera*) and red maple (*Acer rubrum*) as codominants. Canopy and subcanopy associates vary with geography and substrate, but may include southern sugar maple (*Acer barbatum*), American holly (*Ilex opaca*), painted buckeye (*Aesculus sylvatica*), water oak (*Quercus nigra*), bitternut hickory (*Carya cordiformis*), sycamore (*Platanus occidentalis*), river birch (*Betula nigra*), American hornbeam (*Carpinus caroliniana*), flowering dogwood (*Cornus florida*), yellow hawthorn (*Crataegus flava*), American beech (*Fagus grandifolia*), black walnut (*Juglans nigra*), red mulberry (*Morus rubra*), hop hornbeam (*Ostrya virginiana*), sourwood (*Oxydendrum arboreum*), shortleaf pine (*Pinus echinata*), black cherry (*Prunus serotina*), white oak (*Quercus alba*), northern red oak (*Quercus rubra*), elms (*Ulmus rubra*, *U. americana*, and *U. alata*), eastern red cedar (*Juniperus virginiana*), black gum (*Nyssa sylvatica*), white ash (*Fraxinus americana*), and green ash (*Fraxinus pennsylvanica*). The shrub layer often is well-developed and species include strawberry bush (*Euonymus americana*), spicebush (*Lindera benzoin*), American hazelnut (*Corylus americana*), viburnums (*Viburnum acerifolium*, *V. nudum* var. *nudum*, *V. prunifolium*, and *V. rufidulum*), witch-hazel (*Hamamelis virginiana*), pawpaw (*Asimina triloba*), and possum haw (*Ilex decidua*). Vines are prominent and species include round-leaved grape (*Vitis rotundifolia*), American wild bean (*Apios americana*), trumpet creeper (*Campsis radicans*), Virginia snakeroot (*Aristolochia serpentaria*), crossvine (*Bignonia capreolata*), four-leaved wild yam (*Dioscorea quaternata*), Carolina jessamine (*Gelsemium sempervirens*), Virginia creeper (*Parthenocissus quinquefolia*), yellow passion-flower (*Passiflora lutea*), greenbriers (*Smilax bona-nox*, *S. glauca*, *S. hugeri*, and *S. rotundifolia*), and poison-ivy (*Toxicodendron radicans*). The herbaceous layer can be species-rich. Common species include windflower (*Thalictrum thalictroides*), Huger's trillium (*Trillium cuneatum*), jack-in-the-pulpit (*Arisaema triphyllum*), ebony spleenwort (*Asplenium platyneuron*), rattlesnake fern (*Botrychium virginianum*), sedges (*Carex* spp.), wild licorice (*Galium circaezans*), white avens (*Geum canadense*), Christmas fern (*Polystichum acrostichoides*), and helmet flower (*Scutellaria integrifolia*). Soils are relatively acid. The exotic species Japanese stilt grass (*Microstegium vimineum*), Chinese privet (*Ligustrum sinense*), and Japanese honeysuckle (*Lonicera japonica*) may be common in examples of this alliance.

*Thomas Stone NHS and Zekiah Swamp* (adapted from Meininger and McCarthy (1998))

The canopy of this association is dominated by tulip tree (*Liriodendron tulipifera*) and sweet gum (*Liquidambar styraciflua*), with red maple (*Acer rubrum*) the most abundant species in the subcanopy. The dominance of *L. tulipifera* is diagnostic and, in the area of Charles County, serves to distinguish this forest from most associations of floodplains of larger order streams, which tend to be more hydric. Other species which regularly occur in the canopy and/or the subcanopy include beech (*Fagus grandifolia*), black gum (*Nyssa sylvatica*), northern red oak (*Quercus rubra*), bitternut hickory (*Carya cordiformis*) (Thomas Stone NHS only), and sycamore (*Platanus occidentalis*). Less abundant subcanopy trees are American elm (*Ulmus americana*\*), flowering dogwood (*Cornus florida*) (Zekiah only), and American hornbeam (*Carpinus caroliniana*). The species in the shrub layer can be variable, but most commonly include spicebush (*Lindera benzoin*), pawpaw (*Asimina triloba*), and American holly (*Ilex opaca*). Less common shrub species (all at Zekiah only) include sweet pepperbush (*Clethra alnifolia*), sweetbay (*Magnolia virginiana*), highbush blueberry (*Vaccinium corymbosum*), and viburnums (*Viburnum* spp.). The herbaceous layer covers 10 - 50 percent of the forest floor and

is quite diverse. Characteristic species of the herb layer include New York fern (*Thelypteris noveboracensis*), partridge berry (*Mitchella repens*), jack-in-the-pulpit (*Arisaema triphyllum*), lady fern (*Athyrium filix-femina*), Christmas fern (*Polystichum acrostichoides*) (Thomas Stone only), princess-pine (*Lycopodium obscurum*) (Thomas Stone), several sedges (*Carex radiata*, *C. swanii*), Indian cucumber (*Medeola virginiana*) (Zekiah only), and seedlings or sprouts of strawberry bush (*Euonymus americana*). Although the herbaceous flora of this type is comprised mostly of species of mesic to somewhat moist upland forests, small patch wet depressions may support concentrations of species of swamps more characteristic of the *Liquidambar styraciflua* - *Quercus palustris* / *Cinna arundinacea* Forest, such as wood-reed (*Cinna arundinacea*), fowl manna grass (*Glyceria striata*) false nettle (*Boehmeria cylindrica*), and blunt broom sedge (*Carex tribuloides*).

\* Meininger and McCarthy (1998) reported slippery elm (*Ulmus rubra*), but not American elm (*U. americana*), from floodplains at Zekiah Swamp. Since *U. americana* is the more common elm in this region and was seen frequently at Thomas Stone (*U. rubra* was not seen at Thomas Stone NHS) and the two species are frequently confused, it seems possible that reports of *U. rubra* from Zekiah Swamp by Meininger and McCarthy (1998) are actually based on *U. americana*.

NOTEWORTHY SPECIES None noted.

CONSERVATION RANK Unknown

RANK JUSTIFICATION Further information is needed to define the range and extent of this association range and the corresponding rank.

#### COMMENTS

This association seems to more closely match the Piedmont / Low Mountain Alluvial Forests, rather than the Coastal Plain / Piedmont Bottomland Forests of Fleming et al. (2001), as the species composition of the former more closely represents a small, rather than large, stream bottom.

This association is evidently included in the concept of the Maple-Gum Association of the Western Shore District of Shreve et al. (1910).

This vegetation of small stream floodplains (ravine bottoms) is fairly consistent with the floristic and environmental descriptions of the *Liriodendron tulipifera* - *Acer rubrum* - *Liquidambar styraciflua* / *Medeola virginiana* Forest of headwater streams in the Zekiah Swamp watershed, as described by Meininger and McCarthy (1998). The Thomas Stone NHS stands appear to be somewhat more hydric than the Zekiah Swamp headwater stands. In analyses with data sets from that study and from the study of Thomson et al. (1999), the Thomas Stone sample units showed a slightly higher affinity with plots identified as the *Platanus occidentalis* (*Liquidambar styraciflua*, *Liriodendron tulipifera*) / *Asimina triloba* Forest by Thomson et al. (1999). The relationships and differences between of the two types and between these and the Thomas Stone NHS are not presently clear. Most examples of the *Platanus occidentalis* (*Liquidambar styraciflua*, *Liriodendron tulipifera*) / *Asimina triloba* Forest cited by Thomson et al. (1999) were along the main stem of the Potomac, and it is not clear how applicable descriptions of that

association are to small stream floodplains. The nominals of the *Platanus occidentalis* (*Liquidambar styraciflua*, *Liriodendron tulipifera*) / *Asimina triloba* Forest do not seem well suited to the small stream (ravine bottom) type at Thomas Stone, nor necessarily to those sample units of Thomson et al. (1999). In the Maryland forests, *Platanus occidentalis* is often present at low cover, but not constant, while *L. tulipifera* and *L. styraciflua* are of consistent abundance. The co-dominance of *L. tulipifera* is diagnostic and would serve to floristically distinguish this these small stream (ravine bottom) types from types of larger stream floodplains.

The association described here is provisionally identified as a wetter version of the *Liriodendron tulipifera* - *Acer rubrum* - *Liquidambar styraciflua* / *Medeola virginiana* Forest of Zekiah Swamp (Meininger and McCarthy 1998). *Thelypteris noveboracensis*, which is characteristic of both examples, replaces *Medeola virginiana*, which was not seen at Thomas Stone NHS and may be more limited to drier expressions, in the name of the type, as derived from both locations.

The relationship of the *Platanus occidentalis* (*Liquidambar styraciflua*, *Liriodendron tulipifera*) / *Asimina triloba* Forest of Thomson et al. (1999) to the association described here and to similar vegetation described by Meininger and McCarthy (1998) requires further investigation. The distinctions between the *Platanus occidentalis* (*Liquidambar styraciflua*, *Liriodendron tulipifera*) Temporarily Flooded Forest Alliance and the *Liquidambar styraciflua* - (*Liriodendron tulipifera*, *Acer rubrum*) Temporarily Flooded Forest Alliance is not clear. Both appear to include vegetation associated with both small and large order streams and with streams of different gradients. The association concept expressed here is of vegetation of a small (first order) stream bottom that may include *Platanus occidentalis* and *Liquidambar styraciflua*, but also supports more mesic species, including *Liriodendron tulipifera*, *Fagus grandifolia*, and/or *Ilex opaca*. The association described here seems floristically very similar (aside from the absence of some montane elements) to the *Liquidambar styraciflua* - *Liriodendron tulipifera* - (*Platanus occidentalis*) / *Carpinus caroliniana* - *Halesia tetraptera* var. *monticola* / *Amphicarpaea bracteata* Forest of the Great Smoky Mountains, an association placed within the *Platanus occidentalis* (*Liquidambar styraciflua*, *Liriodendron tulipifera*) Temporarily Flooded Forest Alliance that occurs along high gradient streams (NatureServe 2001).

This type occupies the same environmental position as, and is analogous to the beech - tulip poplar variant of the *Fagus grandifolia* - *Quercus alba* / *Podophyllum peltatum* Forest of Rock Creek Park (The Nature Conservancy 1998) and the *Fagus grandifolia* - *Liriodendron tulipifera* Forest of Thomson et al. (1999), both of which are likely the same association. Both have characteristics of *Liriodendron tulipifera* as a dominant, with *Fagus grandifolia* often codominant, and *Platanus occidentalis* often present at low abundance, and they share many of the same herbaceous species.

## PLOTS

302

312

421 (transitional to *Liquidambar styraciflua* - *Quercus palustris* / *Cinna arundinacea* Forest)

## ***Liriodendron tulipifera* / *Lindera benzoin* Forest**

COMMON NAME	Tulip tree / Spicebush forest
SYNONYM	Mesic Forest
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	I. Forest
PHYSIOGNOMIC SUBCLASS	IB. Deciduous forest
PHYSIOGNOMIC GROUP	IB2. Cold-deciduous forest
PHYSIOGNOMIC SUBGROUP	IB2N. Natural/Semi-natural cold-deciduous forest
FORMATION	IB2Na. Lowland or submontane cold-deciduous forest
ALLIANCE	IB2Na24. <i>Liriodendron tulipifera</i> Forest Alliance

### **CLASSIFICATION CONFIDENCE LEVEL 1**

#### **RANGE (alliance)**

The *Liriodendron tulipifera* Forest Alliance is widespread in the southeastern United States (NatureServe Explorer 2001). It is most common in the central and southern Appalachians at lower elevations, but also occurs on the Coastal Plain and in the Piedmont in the mid-Atlantic states. It occurs in Alabama, Georgia, Tennessee, Kentucky, North Carolina, South Carolina, Virginia, and probably other locations as well.

**ENVIRONMENTAL DESCRIPTION** At Thomas Stone NHS, this forest association occurs on flat to concave shaped, moderately steep (2-12%) slopes of ravines, generally below 46 meters (150 feet) in elevation. At least one stand occurs on what is apparently a higher, well-drained stream terrace along Hoghole Run. The soil surface is approximately 80-90% covered with a layer of leaf litter, which is typically thin, with bare soil patches occurring elsewhere. A humus layer is very shallow, when present at all. Soils were found in the field to be gravelly loams or gravelly sandy loams, probably ultisols, and are very stony, with frequent rounded gravel particles up to 2 cm in diameter. Organic matter is well-mixed with mineral soil to a depth well below the soil surface, so that the A horizon is deep, with the mineral soil color obscured within the upper 25 cm. Soil pH was measured to be from 4.3 to 4.6 in younger stands and from 4.9 to 5.3 in older stands. Areas in which stands of this type occur are mapped mostly as Aura gravelly sandy loam or Croom gravelly loam. The association is evidently an early seral stage following clearing of dry-mesic to mesic forests on slopes.

**USFWS WETLAND SYSTEM** Not applicable

#### **MOST ABUNDANT SPECIES**

*Thomas Stone NHS*

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Liriodendron tulipifera</i>
Subcanopy	<i>Cornus florida</i> , <i>Carpinus caroliniana</i> , <i>Acer rubrum</i>
Shrub	<i>Lindera benzoin</i> , <i>Ilex opaca</i> , <i>Fagus grandifolia</i>
Herbaceous	<i>Arisaema triphyllum</i> , <i>Festuca subverticillata</i>

DIAGNOSTIC SPECIES *Liriodendron tulipifera*, *Cornus florida*, *Lindera benzoin*, *Festuca subverticillata*, *Galium circaezans*, *Circaea lutetiana*, *Botrychium virginianum*, *Carex amphibola*, *Carya cordiformis*, *Sanicula canadensis*, *Juglans nigra*

OTHER CHARACTERISTIC SPECIES *Fraxinus americana*, *Liquidambar styraciflua*, *Asimina triloba*, *Lonicera japonica*, *Asplenium platyneuron*, *Parthenocissus quinquefolia*, *Campsis radicans*, *Carex swanii*, *Galium tinctorium*, *Polystichum acrostichoides*, *Smilax rotundifolia*, *Toxicodendron radicans*, *Vitis vulpina*, *Cystopteris protrusa*, *Rubus hispidus*, *Elymus virginicus*, *Botrychium dissectum*, *Osmorhiza claytonii*, *Dichanthelium boscii*

DIAGNOSTIC SPECIES *Liriodendron tulipifera*

#### VEGETATION DESCRIPTION

Globally (adapted from NatureServe Explorer 2001)

The *Liriodendron tulipifera* Forest Alliance is characterized by a strong dominance of tulip tree (*Liriodendron tulipifera*), often in pure stands, in the canopy. Rangewide, associates include red maple (*Acer rubrum*), locust (*Robinia pseudoacacia*), boxelder (*Acer negundo*), sugar maple (*Acer saccharum*) and black birch (*Betula lenta*). Sweet gum (*Liquidambar styraciflua*) is common in Coastal Plain and Piedmont locations. Vines can be abundant including grape (*Vitis* spp.), greenbrier (*Smilax* spp.), and Virginia creeper (*Parthenocissus quinquefolia*).

*Thomas Stone NHS*

This association is typically dominated by tulip tree (*Liriodendron tulipifera*) in the canopy, usually with no codominant species. Sweet gum (*Liquidambar styraciflua*) is frequent, but occurs at low cover. Black walnut (*Juglans nigra*) is uncommon, but characteristic. The subcanopy and tall shrub layer are usually sparse, with red maple (*Acer rubrum*), flowering dogwood (*Cornus florida*), and American hornbeam (*Carpinus caroliniana*) most frequent. Spicebush (*Lindera benzoin*) is consistently the dominant shrub, with cover ranging from about 10% in drier expressions to nearly 75% in more mesic stands. American holly (*Ilex opaca*) and beech (*Fagus grandifolia*) are also present as tall shrubs, usually at low cover. The herb layer is quite diverse and consists of typical species of rich upland forests, including some calciphilic species. Jack-in-the-pulpit (*Arisaema triphyllum*) and nodding fescue (*Festuca subverticillata*) are the most frequent herbs, with wild licorice (*Galium circaezans*), enchanter's nightshade (*Circaea lutetiana*), rattlesnake fern (*Botrychium virginianum*), eastern narrowleaf sedge (*Carex amphibola*), white avens (*Geum canadense*), Canada snakeroot (*Sanicula canadensis*), Christmas fern (*Polystichum acrostichoides*), and Bosc's panic grass (*Dichanthelium boscii*) also characteristic. Weedy species such as southern dewberry (*Rubus hispidus*) and Japanese honeysuckle (*Lonicera japonica*) are often present.

A variant that probably represent older stands that have escaped recent clearing and are succeeding to a later seral type is present in small patches. This variant has species other than *L. tulipifera*, primarily bitternut hickory (*Carya cordiformis*), and/or northern red oak (*Quercus rubra*) codominant.

More disturbed, stands may have various other early successional species, such as eastern red cedar (*Juniperus virginiana*), Virginia pine (*Pinus virginiana*), or pin oak (*Quercus palustris*) present.

At Thomas Stone NHS, the *Liriodendron tulipifera* / *Lindera benzoin* Forest is distinguished from the *Fagus grandifolia* - *Quercus rubra* - *Quercus alba* / *Carpinus caroliniana* Forest (drier versions of the former association may represent stands succeeding to the latter association), by (1) the position of *Liriodendron tulipifera* as a strongly leading dominant in the canopy, (2) by the presence of *Lindera benzoin* as a significant component of the shrub layer, and (3) (in some stands) by the presence of species which are characteristic of circumneutral soils (e.g., *Juglans nigra*, *Cystopteris protrusa*, *Festuca subverticillata*, *Carex amphibola*, *Circaea lutetiana*).

The *Liriodendron tulipifera* / *Lindera benzoin* Forest is distinguished from *Liriodendron tulipifera* - *Acer rubrum* - *Liquidambar styraciflua* / *Thelypteris noveboracensis* Forest by the lack of dominant species other than *L. tulipifera* and the rarity or absence of species of more hydric situations (e.g., *Platanus occidentalis*, *Ulmus americana*, *Leersia virginica*, *Boerhaavia cylindrica*).

#### NOTEWORTHY SPECIES

An undescribed species of sedge (genus *Carex*, section *Laxiflorae*), evidently near the northern limit of its [primarily southeastern United States] range, has been found in this vegetation type at Thomas Stone NHS. This is the only known site in Maryland at which the entity species is extant.

CONSERVATION RANK    Unknown

#### RANK JUSTIFICATION

Further information is needed to define the range and extent of this association range and the corresponding rank. Although early successional Tulip Tree forests are widespread, stands supporting a more-or-less calciphilic flora may be somewhat uncommon in Maryland.

#### COMMENTS

This type would most likely be included in the Basic Mesic Forests (a somewhat early seral type) of Fleming et al. (2001).

This type is evidently included in the concept of the Oak-Hickory Association of the Western Shore District of Shreve et al. (1910).

Comparison of the herbaceous layer of these forests with those of nearby Chapman Forest, a mature basic mesic [shell marl] forest suggest that [at least] the more mesic stands at Thomas



Stone NHS may succeed to the a calcareous or calcareous-like type, possibly in the *Fagus grandifolia* - *Acer saccharum* - (*Liriodendron tulipifera*) Forest Alliance. Drier stands will likely succeed to the *Fagus grandifolia* - *Quercus rubra* - *Quercus alba* / *Carpinus caroliniana* Forest.

The somewhat low pH measurements for stands of this type (slightly higher than for the dry oak forests) seem inconsistent with the rich woods flora in them, but is consistent with the assessment of Hall and Mathews (1974) that Aura gravelly sandy loams are strongly acidic. This has yet to be explained, though these forests may be rich in some essential plant nutrients, despite their low pH.

#### PLOTS

202

212

401

411 (transitional to *Fagus grandifolia* - *Quercus rubra* - *Quercus alba* / *Carpinus caroliniana* Forest)

***Acer rubrum* - *Nyssa sylvatica* - *Magnolia virginiana* Forest**

COMMON NAME	Red maple - Black gum - Sweet bay Forest
SYNONYM	Seepage Swamp (Coastal Plain Seepage Swamp)
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	I. Forest
PHYSIOGNOMIC SUBCLASS	IB. Deciduous forest
PHYSIOGNOMIC GROUP	IB2. Cold-deciduous forest
PHYSIOGNOMIC SUBGROUP	IB2N. Natural/Semi-natural cold-deciduous forest
FORMATION	IB2Ng. Saturated cold-deciduous Forest
ALLIANCE	IB2Ng2. <i>Acer rubrum</i> - <i>Nyssa sylvatica</i> Saturated Forest Alliance

**CLASSIFICATION CONFIDENCE LEVEL 1**

**RANGE (alliance)**

The range of the *Acer rubrum* - *Nyssa sylvatica* Saturated Forest Alliance is throughout the Eastern United States (NatureServe Explorer 2001).

**ENVIRONMENTAL DESCRIPTION**

This association is a partially open to closed canopy wetland forest associated with hillside or toe-slope seepage. At Thomas Stone NHS, it occurs along the gently sloping bottoms of ravines of tributary streams to Hoghole Run, within a matrix of upland forest. Hydrology is dominated by ground water, and the soil is saturated to the surface probably essentially year round, with patches of standing to slowly flowing water usually present, except perhaps under very dry conditions. Vegetated areas are interspersed with flowing channels and standing pools of water. Soils are typically alternately muck or nearly pure gravelly sand. Areas in which stands of this type occurs are mapped as Aura gravelly sandy loam. The water is generally assumed to be acidic, but apparently only mildly so at Thomas Stone NHS (5.7 to 6.2 at the two examples studied).

**USFWS WETLAND SYSTEM** Palustrine.

**MOST ABUNDANT SPECIES**

<u>Stratum</u>	<u>Species</u>
Tree canopy	If present, comprised of various species of trees from surrounding drier forests
Subcanopy	<i>Acer rubrum</i> , <i>Nyssa sylvatica</i>
Shrub	<i>Magnolia virginiana</i> , <i>Lindera benzoin</i> , <i>Chionanthus virginicus</i> , <i>Ilex verticillata</i>
Herbaceous	<i>Boehmeria cylindrica</i> , <i>Leersia virginica</i> , <i>Carex seorsa</i> , <i>Woodwardia areolata</i> ,

*Impatiens capensis*, *Symplocarpus foetidus*, *Lycopus virginicus*

DIAGNOSTIC SPECIES *Magnolia virginiana*, *Ilex verticillata*, *Chionanthus virginicus*, *Viburnum nudum*, *Carex atlantica* ssp. *atlantica*, *C. atlantica* ssp. *capillacea*

OTHER CHARACTERISTIC SPECIES *Carex laevivaginata*, *Carex lurida*, *Carex styloflexa*, *Carex debilis*, *Carex crinita*, *Chelone glabra*, *Vaccinium corymbosum*, *Viola cucullata*, *Oxypolis rigidior*, *Scirpus polyphyllus*, *Sphagnum* sp.

#### VEGETATION DESCRIPTION

Globally (adapted, in part, from Fleming et al. (2001)

(Coastal Plain / Piedmont Acidic Seepage Swamps of Virginia)

Dominant canopy species are *Acer rubrum* and *Nyssa sylvatica*. Common small trees and shrubs include *Magnolia virginiana*, *Clethra alnifolia*, *Vaccinium* spp., *Rhododendron viscosum*, and *Viburnum nudum* var. *nudum*. Common herbaceous species are *Symplocarpus foetidus* and *Osmunda cinnamomea*. The herbaceous layer is primarily comprised of obligate or near-obligate wetland species, is often fairly diverse, and may include regionally or locally uncommon or rare species.

#### *Thomas Stone NHS and Zekiah Swamp*

Red maple (*Acer rubrum*) and black gum (*Nyssa sylvatica*) in the uppermost tree layer characterize this type, which may be quite open in some examples. This layer is characterized best as a subcanopy. A canopy, if present, is usually comprised of species of trees rooted outside of the community and overhanging it. Subcanopy or tall shrub associates of the dominant species include sweetbay (*Magnolia virginiana*), and American holly (*Ilex opaca*) (the latter at Zekiah only). The shrub layer is characterized by spicebush (*Lindera benzoin*) (Thomas Stone only), highbush blueberry (*Vaccinium corymbosum*), fringe tree (*Chionanthus virginicus*) (Thomas Stone only), sweet pepperbush (*Clethra alnifolia*) (Zekiah only), winterberry (*Ilex verticillata*), and swamp azalea (*Rhododendron viscosum*) (Zekiah only). The herbaceous layer occurs on hummocks of higher ground and along the edges of pools of water and includes cinnamon fern (*Osmunda cinnamomea*) (Zekiah only), skunk cabbage (*Symplocarpus foetidus*), chain fern (*Woodwardia areolata*), and a number of wetland sedges (*Carex* spp). Peat moss (*Sphagnum* sp.) and other mosses are common, but generally do not form extensive mats.

NOTEWORTHY SPECIES None noted

CONSERVATION RANK Unknown

#### RANK JUSTIFICATION

Further information is needed to define the range and extent of this association range and the corresponding rank. The association occurs in small patches, is vulnerable to hydrologic disturbances, and may be of some conservation concern in Maryland.

#### COMMENTS

The nomenclature used for this association is the same as what is undoubtedly the same vegetation in Zekiah Swamp, as described by Meininger and McCarthy (1998), who

synonymized it with depression swamps at Assateague Island National Seashore (The Nature Conservancy 1995). While both inner Coastal Plain seepages and Outer Coastal Plain depression swamps share some vegetation similarities (e.g., prevalence of *Acer rubrum* and *Nyssa sylvatica* in the tree layer), their grouping together within various levels of the NVCS probably needs review, given the differences in hydrologic, landscape, and [perhaps] geographical setting.

This association typically occurs in small patches. Only two examples of significant size (100-150 m<sup>2</sup>) were seen in Thomas Stone NHS, although elements can be identified in extremely small patches elsewhere. This type corresponds to the Coastal Plain / Piedmont Acidic Seepage Swamps of Fleming et al. (2001) and the Low Elevation Seep of Schafale and Weakley (1990).

The so-called "magnolia bogs" (e.g., Coastal Plain / Piedmont Seepage Bogs of Fleming et al. (2001)), are a closely related type that is probably worthy of classification as a distinct association Hillside Seepage Bog of Schafale and Weakley (1990). They are believed to be globally rare and endemic to the Maryland-Virginia inner Coastal Plain area, with good examples occurring in Charles County (Simmons and Strong 2001). These are more open (they probably are characterized best as Shrublands within the NVCS), and more extremely acidic (e.g. water pH often less than 5.0), and have *Sphagnum* more abundant. They share many of the same species as the association described here, but often have lower species diversity per unit area (although they may support larger numbers of rare or restricted species).

#### PLOTS

221

321

### ***Liquidambar styraciflua* - *Acer rubrum* - *Quercus phellos* Forest**

COMMON NAME	Sweet gum - Red maple - Willow oak Forest
SYNONYM	Upland Depression Swamp
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	I. Forest
PHYSIOGNOMIC SUBCLASS	IB. Deciduous forest
PHYSIOGNOMIC GROUP	IB2. Cold-deciduous forest
PHYSIOGNOMIC SUBGROUP	IB2N. Natural/Semi-natural cold-deciduous Forest
FORMATION	IB2Ne. Seasonally flooded cold-deciduous Forest
ALLIANCE	IB2Ne6. <i>Liquidambar styraciflua</i> - ( <i>Acer rubrum</i> ) Seasonally Flooded Forest Alliance

#### **CLASSIFICATION CONFIDENCE LEVEL 1**

##### **RANGE (alliance)**

The range of the *Liquidambar* - (*Acer rubrum*) Seasonally Flooded Forest Alliance is throughout the southeastern United States north to New York and New Jersey (NatureServe Explorer 2001). The *Liquidambar styraciflua* - *Acer rubrum* - *Quercus phellos* / *Leucothoe racemosa* Forest, which may be synonymous with this association, occurs on the Coastal Plain in Virginia, Maryland, Delaware, New Jersey, New York, and, possibly, Pennsylvania.

##### **ENVIRONMENTAL DESCRIPTION**

This association occurs in depressions in uplands over a perched water table that is seasonally maintained by a relatively impermeable fragipan. The single large example seen was in an area mapped as Beltsville silt loam, within a matrix of *Quercus alba* - *Fagus grandifolia* / *Vaccinium pallidum* Forest. Although they may have a small surface and ground water recharge area, seasonal pools associated with a perched water table are recharged mainly by significant periods of precipitation and probably have lower amounts of nutrients delivered compared to wetlands with more predictable recharge regimes. Standing water may remain above the surface for long periods (weeks or more) in winter or early spring, as suggested by high water lines near tree bases. Increased rates of evapotranspiration typically cause rapid loss of water during the growing season, during which the soil can be dry at the surface, but is generally moist a few centimeters below the surface. In the single example at Thomas Stone NHS, the soil surface cover was comprised of about 15% bare soil and 85% poorly decomposed, water-stained leaves. A humus layer of about 2 cm depth was usually present at the soil surface, and the upper 2-3 cm of the soil column was stained brown with organic matter. Below this point, the soil column exhibited gleying with mottles to a depth of at least 25-30 cm, and was yellow-orange from below this point to the top of the fragipan, which occurred at 25-60 cm depth, a pattern indicative

of a perched water table with frequently fluctuating levels. The average soil pH (n=3) in the single example was 4.5.

USFWS WETLAND SYSTEM      Palustrine.

#### MOST ABUNDANT SPECIES

*Thomas Stone NHS*

<u>Stratum</u>	<u>Species</u>
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Tree canopy	<i>Liquidambar styraciflua</i> , <i>Quercus phellos</i>
Subcanopy	<i>Acer rubrum</i> , <i>Nyssa sylvatica</i> , <i>Betula nigra</i>
Tall shrub	<i>Vaccinium corymbosum</i> , <i>Liquidambar styraciflua</i>
Vine/liana	<i>Smilax rotundifolia</i>
Herbaceous	<i>Carex albolutescens</i> , <i>Juncus effusus</i> , <i>Scirpus cyperinus</i>

DIAGNOSTIC SPECIES *Quercus phellos*, *Carex albolutescens*

OTHER CHARACTERISTIC SPECIES , *Carex swanii*, *Ludwigia palustris*, *Toxicodendron radicans*, *Parthenocissus quinquefolia*, *Clethra alnifolia*, *Juncus tenuis*, *Carex complanata*

#### VEGETATION DESCRIPTION

*Globally* (adapted, in part, from NatureServe Explorer (2001))

In the *Liquidambar styraciflua* - *Acer rubrum* - *Quercus phellos* / *Leucothoe racemosa* Forest of the *Liquidambar styraciflua* - (*Acer rubrum*) Seasonally Flooded Forest Alliance, red maple (*Acer rubrum*), sweet gum (*Liquidambar styraciflua*), and black gum (*Nyssa sylvatica*) are constant tree species, with American holly (*Ilex opaca*), sweetbay (*Magnolia virginiana*), sassafras (*Sassafras albidum*), pin oak (*Quercus palustris*), loblolly pine (*Pinus taeda*), and willow oak (*Quercus phellos*) often associated. The shrub layer is usually comprised of fetterbush (*Leucothoe racemosa*), highbush blueberry (*Vaccinium corymbosum*), coastal sweet pepperbush (*Clethra alnifolia*), and swamp azalea (*Rhododendron viscosum*). Round-leaved greenbrier (*Smilax rotundifolia*) is a particularly characteristic vine. The herbaceous layer is sparse and may include partridge berry (*Mitchella repens*), cinnamon fern (*Osmunda cinnamomea*), netted chain fern (*Woodwardia areolata*), sensitive fern (*Onoclea sensibilis*), and smartweeds (*Polygonum* spp).

*Thomas Stone NHS*

The tree layer is relatively diverse and dominated by species tolerant of prolonged flooding, with sweet gum (*Liquidambar styraciflua*), red maple (*Acer rubrum*) and black gum (*Nyssa sylvatica*) most numerous. Willow oak (*Quercus phellos*) and river birch (*Betula nigra*), are present. A few small individuals of white oak (*Quercus alba*) (which is common in the surrounding forest) occur on slightly elevated areas. The shrub layer is sparse and comprised mostly of sweet gum (*Liquidambar styraciflua*) saplings and highbush blueberry (*Vaccinium corymbosum*). A sometimes dense, low growth of round-leaved greenbrier (*Smilax rotundifolia*) climbs on shrubs or the lower parts of trees or is freestanding. The herbaceous layer is very sparse, depauperate, and mostly limited to the rim of the pool, with green-white sedge (*Carex albolutescens*) a characteristic and the most frequent species. Widely scattered individuals of wetland species

such as soft rush (*Juncus effusus*), wool-grass (*Scirpus cyperinus*), and swamp purslane (*Ludwigia palustris*) grow in the pool interior.

NOTEWORTHY SPECIES None noted.

CONSERVATION RANK Unknown

#### RANK JUSTIFICATION

Further information is needed to define the range and extent of this association range and the corresponding rank. The association occurs in small patches, is vulnerable to hydrologic disturbances, and may be of some conservation concern in Maryland. It will probably merit a state rank of S3 or possibly higher.

#### COMMENTS

Since this vegetation is associated with vernal pools, it likely occupies wetlands of significant plant and animal value, as defined by Maryland wetland regulations (COMAR 26.23.01.01).

This type would be included in the Upland Depression Swamps of Fleming et al. (2001).

This type is floristically very similar to the *Acer rubrum* - *Nyssa sylvatica* - *Betula nigra* Forest of the Potomac River Gorge of the Piedmont (= *Acer rubrum* - *Nyssa sylvatica* / *Smilax rotundifolia* / *Carex* spp. Forest of Lea (2000)). The latter occupies seasonally flooded pools over a clay layer accumulated in depressions over rarely flooded bedrock river terraces. *Liquidambar styraciflua* is absent in the Potomac Gorge expressions. The assignment of seasonally flooded upland depressions dominated by *Acer rubrum* and *Nyssa sylvatica* to *Acer rubrum* - *Nyssa sylvatica* Saturated Forest Alliance (to which seepage swamps are also assigned) may not be appropriate and should be reviewed. On a wide geographic scale, the *Liquidambar styraciflua* - (*Acer rubrum*) Seasonally Flooded Forest Alliance might best be treated as a subset of upland depression swamp vegetation that has *Acer rubrum* and *Nyssa sylvatica* characteristic. Such vegetation is currently included in the *Acer rubrum* - *Nyssa sylvatica* Saturated Forest Alliance, but the hydrologic regime of these occurrences might be better characterized as seasonally flooded.

This type is similar to the hardwood swamp forest of southern New Jersey of Collins and Anderson (1994).

#### PLOTS

603

***Liquidambar styraciflua* - *Quercus palustris* / *Cinna arundinacea* Forest**

COMMON NAME	Sweet gum - Pin oak / Woodreed Forest
SYNONYM	Floodplain Swamp Forest
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	I. Forest
PHYSIOGNOMIC SUBCLASS	IB. Deciduous forest
PHYSIOGNOMIC GROUP	IB2. Cold-deciduous forest
PHYSIOGNOMIC SUBGROUP	IB2N.Natural/Semi-natural cold-deciduous forest
FORMATION	IB2Ne.Seasonally Flooded cold-deciduous Forest
ALLIANCE	Unknown (possibly <i>Quercus palustris</i> - <i>Acer rubrum</i> Temporarily Flooded Forest Alliance or <i>Quercus palustris</i> - ( <i>Quercus bicolor</i> ) Seasonally Flooded Forest Alliance)

**CLASSIFICATION CONFIDENCE LEVEL 3**

**RANGE (alliance)**

The alliance to which this vegetation should be assigned likely has a wide range that includes the mid-Atlantic and southeastern states on the Coastal Plain and Piedmont. The ranges of both the *Quercus palustris* - *Acer rubrum* Temporarily Flooded Forest Alliance and *Quercus palustris* - (*Quercus bicolor*) Seasonally Flooded Forest Alliance are to the north of Maryland, and this may be a southern expression of one of those alliances.

**ENVIRONMENTAL DESCRIPTION**

At Thomas Stone NHS, this forest association occurs on lower parts of the floodplain of Hoghole Run, which are regularly flooded by overbank flow, with a probable return interval of one year or less. Due to the occupation of most of the floodplain within and adjacent to the park boundaries by a power line right-of-way, this association is limited at Thomas Stone NHS to small patches adjacent to vegetation of higher floodplain areas and low upland slopes. The soil surface is generally 85-90% covered with a layer of leaf litter that is generally 0.5 to 1 cm deep, with bare soil present elsewhere. A brown-stained organic/mineral (A) horizon is usually present and is typically from 3 to 5 cm deep and sometimes deeper in better-drained areas. The mineral horizon is somewhat to strongly gleyed, with mottles consistently present to near the soil surface. Soils are poorly drained silt loams to silty clay loams with little gravel present, and areas in which stands of this type occurs are mapped exclusively as Bibb silt loam. Soil pH was measured to be from 4.5 to 4.7.

USFWS WETLAND SYSTEM	Palustrine
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## MOST ABUNDANT SPECIES

Thomas Stone NHS

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Liquidambar styraciflua</i> , <i>Platanus occidentalis</i> , <i>Quercus palustris</i> , <i>Betula nigra</i> ,
Subcanopy	<i>Acer rubrum</i> , <i>Carpinus caroliniana</i> , <i>Ulmus americana</i>
Tall shrub	<i>Lindera benzoin</i> , <i>Asimina triloba</i>
Vine/liana	<i>Toxicodendron radicans</i> , <i>Smilax rotundifolia</i> , <i>Lonicera japonica</i> , <i>Parthenocissus quinquefolia</i> , <i>Campsis radicans</i>
Herbaceous	<i>Cinna arundinacea</i> , <i>Boehmeria cylindrica</i> , <i>Glyceria striata</i> , <i>Carex debilis</i> , <i>Carex intumescens</i> , <i>Carex tribuloides</i> , <i>Leersia virginica</i>

DIAGNOSTIC SPECIES *Quercus palustris*, *Betula nigra*, *Cinna arundinacea*, *Boehmeria cylindrica*, *Glyceria striata*, *Carex intumescens*, *Carex tribuloides*

OTHER CHARACTERISTIC SPECIES *Athyrium filix-femina*, *Arisaema triphyllum*, *Solidago rugosa*, *Symphotrichum lanceolatum*, *Lycopus virginiana*, *Lobelia cardinalis*, *Carex crinita*, *Carex squarrosa*, *Galium tinctorium*, *Onoclea sensibilis*, *Carya cordiformis*

## VEGETATION DESCRIPTION

Globally (adapted, in part, from Meininger and McCarthy (1998) (*Liquidambar styraciflua* - *Quercus palustris* / *Carpinus caroliniana* / *Carex intumescens* Forest) and Thomson et al. (1999) (*Quercus (palustris, phellos)* - *Acer rubrum* / *Cinna arundinacea* Forest).

The canopy layer of this forest is diverse, and a variety of species can be locally dominant including sweet gum (*Liquidambar styraciflua*), red maple (*Acer rubrum*), green ash (*Fraxinus pennsylvanica*), and flood-tolerant oaks, such as pin (*Quercus palustris*), cherrybark (*Q. pagoda*), basket (*Q. michauxii*), and willow (*Q. phellos*). The understory is well developed and characteristically includes a dense layer of American hornbeam (*Carpinus caroliniana*), as well as basket oak (*Quercus michauxii*), red maple (*Acer rubrum*), and American elm (*Ulmus americana*\*). American holly (*Ilex opaca*), spicebush (*Lindera benzoin*), and pawpaw (*Asimina triloba*) characterize the shrub layer. Shrubs that are occasionally found include winterberry (*Ilex verticillata*), possum haw (*I. decidua*), black haw (*Viburnum prunifolium*), and southern arrowwood (*V. dentatum*). The herbaceous layer can be quite dense and is characterized by woodreed (*Cinna arundinacea*), greater bladder sedge (*Carex intumescens*), white-edge sedge (*C. debilis*), sensitive fern (*Onoclea sensibilis*), jack-in-the-pulpit (*Arisaema triphyllum*), and wrinkle-leaf goldenrod (*Solidago rugosa*). There are signs of temporary and seasonal flooding on the forest floor, including dried pool areas and intermittent channels. Bark on the lower tree trunks is moss covered.

\* Meininger and McCarthy (1998) reported slippery elm (*Ulmus rubra*), but not American elm (*U. americana*), from floodplains at Zekiah Swamp. Since *U. americana* is the more common elm in this region and was seen frequently at Thomas Stone (*U. rubra* was not seen at Thomas Stone NHS) and the two species are frequently confused, it seems possible that reports of *U. rubra* from Zekiah Swamp by Meininger and McCarthy (1998) are actually based on *U. americana*.

Thomas Stone NHS

Examples at Thomas Stone NHS have been affected by past clearing, with the diagnostic late seral tree species relatively rare, but they show the characteristic species of the associations described by Meininger and McCarthy (1998) and Thomson et al. (1999) in the shrub and herbaceous layers. The tree canopy layer may not be well stratified, and typically has sweet gum (*Liquidambar styraciflua*) and red maple (*Acer rubrum*) as leading dominants. Pin oak (*Quercus palustris*), sycamore (*Platanus occidentalis*), bitternut hickory (*Carya cordiformis*), and river birch (*Betula nigra*) are present at low cover. Tulip tree (*Liriodendron tulipifera*) is sometimes present, but its occurrence may be characteristic of early successional stands, as occur at Thomas Stone NHS, only. Basket oak (*Quercus michauxii*) seedlings were present (and rare), but mature trees of this species were not seen. Frequent understory trees or tall shrubs are American hornbeam (*Carpinus caroliniana*) and American elm (*Ulmus americana*). Spicebush (*Lindera benzoin*) and pawpaw (*Asimina triloba*) are the most common species of the shrub layer. Tree-climbing vines are common and include poison ivy (*Toxicodendron radicans*), round-leaved greenbrier (*Smilax rotundifolia*), Japanese honeysuckle (*Lonicera japonica*), Virginia creeper (*Parthenocissus quinquefolia*), and trumpet creeper (*Campsis radicans*). In the herbaceous layer, sparse to relatively dense stands of wood-reed (*Cinna arundinacea*), false nettle (*Boehmeria cylindrica*) and/or manna grass (*Glyceria striata*) are characteristic. Several sedges (*Carex intumescens*, *C. debilis*, *C. tribuloides*), white grass (*Leersia virginica*), and jack-in-the-pulpit (*Arisaema triphyllum*) are frequent. American elderberry (*Sambucus nigra* ssp. *canadensis*), wrinkle-leaved goldenrod (*Solidago rugosa*), white panicle aster (*Symphyotrichum lanceolatum*), Virginia bugleweed (*Lycopus virginiana*), several sedges (*Carex crinita*, *C. squarrosa*), swamp bedstraw (*Galium tinctorium*), and sensitive fern (*Onoclea sensibilis*) are characteristic species that are usually present at low cover.

Throughout southern Maryland, the *Liquidambar styraciflua* - *Quercus palustris*/ *Cinna arundinacea* Forest can be distinguished from the *Liriodendron tulipifera* - *Acer rubrum* - *Liquidambar styraciflua*/*Thelypteris noveboracensis* Forest by the absence of tulip tree (*Liriodendron tulipifera*) as a codominant in the canopy. (At Thomas Stone NHS, *L. tulipifera* occurs in some stands due to their early seral stage and their proximity to *L. tulipifera*-dominated forest types). The two are also distinguished by the prevalence of obligate or near-obligate wetland species in the herbaceous layer of the *Liquidambar styraciflua* - *Quercus palustris*/ *Cinna arundinacea* Forest. (These occasionally may be present in the *Liriodendron tulipifera* - *Acer rubrum* - *Liquidambar styraciflua*/*Thelypteris noveboracensis* Forest, but tend to be restricted to poorly drained, small patch depressions). The *Liriodendron tulipifera* - *Acer rubrum* - *Liquidambar styraciflua*/*Thelypteris noveboracensis* Forest occurs along the main bottoms along smaller order streams and, sometimes, of lower slopes or higher parts of the floodplain of medium-sized streams. In the latter situation, the two types may occur alongside each other.

NOTEWORTHY SPECIES None noted.

CONSERVATION RANK Unknown

#### RANK JUSTIFICATION

Further information is needed to define the range and extent of this association range and the corresponding rank.

## COMMENTS

This association closely fits the Piedmont / Mountain Swamp Forests of Fleming et al. (2001).

This association is evidently included in the concept of the River Swamps Association of the Western Shore District of Shreve et al. (1910).

Resolution of the various Coastal Plain medium-sized stream floodplain forests of Meininger et al. (1998) and Thomson et al. (1999) is needed to adequately place this type. Such forests are not extensive at Thomas Stone NHS, and they are affected by clearing in the recent past; thus, they may be less dominated by late seral swamp species that are diagnostic and are somewhat rare. The examples of this type at Thomas Stone NHS appear to fit at least partially within the *Quercus (palustris, phellos) - Acer rubrum / Cinna arundinacea* Forest of Thomson et al. (1999), although elements of the *Liquidambar styraciflua - Quercus palustris / Carpinus caroliniana/Carex intumescens* Forest of Meininger and McCarthy (1998) are present. It is possible that the former type is synonymous with or includes the wetter parts of the latter type, which may also include less hydric floodplain forests that may be northern range extensions of the *Quercus (michauxii, pagoda, shumardii) - Liquidambar styraciflua* Temporarily Flooded Forest Alliance and are not yet well-defined for Maryland. It is probable that these less hydric floodplain forests occur or once occurred along Hoghole Run, but no such forests were detected by this study.

The assignment of floodplain swamp forests at the formation level within the NVCS may be problematic for vegetation similar to that described here. This may be because of difficulties in discerning their hydrology. Floodplain swamp forests are more hydric than forests on levees or topographically higher parts of floodplains (which are usually placed in Temporarily Flooded alliances) and are often floristically and hydrologically similar to upland swamp forests, which are placed in Seasonally Flooded alliance types. There seems to be some need to develop or better define Coastal Plain seasonally flooded bottomland (i.e., floodplain swamp) vegetation that includes vegetation as described here.

The association described here is given the provisional name of *Liquidambar styraciflua - Quercus palustris / Cinna arundinacea* Forest, to preserve the most descriptive nominals of the applicable types described by Meininger and McCarthy (1998) and Thomson et al. (1999), with the expectation that some reorganization of these types is warranted.

## PLOTS

502

511

222 (transitional from *Liquidambar styraciflua* Forest)

***Liquidambar styraciflua* Forest (*Liquidambar styraciflua* Shrubland)**

COMMON NAME	Sweet gum Forest (Sweet gum Shrubland)
SYNONYM	Early Successional Upland Sweet Gum Forest (Shrubland)
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	I. Forest III. Shrubland
PHYSIOGNOMIC SUBCLASS	IB. Deciduous forest IIIB. Deciduous shrubland
PHYSIOGNOMIC GROUP	IB2. Cold-deciduous forest IIIB2. Cold-deciduous shrubland
PHYSIOGNOMIC SUBGROUP	IB2N. Natural/Semi-natural cold-deciduous forest IIIB2N. Natural/Semi-natural cold-deciduous shrubland
FORMATION	IB2Na. Lowland or submontane cold-deciduous forest IIIB2Na. Temperate cold-deciduous shrubland
ALLIANCE	IB2Na22. <i>Liquidambar styraciflua</i> Forest Alliance (may require a <i>Liquidambar styraciflua</i> Shrubland Alliance)

**CLASSIFICATION CONFIDENCE LEVEL 1**

**RANGE (alliance)**

The *Liquidambar styraciflua* Forest Alliance is widespread throughout the southeastern United States in most physiographic provinces (NatureServe Explorer 2001) and probably occurs north at least to New Jersey on the Coastal Plain. In Maryland it is restricted to the Coastal Plain.

**ENVIRONMENTAL DESCRIPTION**

This type occurs in abandoned fields and in utility rights of way that have not been mowed in several years or where mowing has ceased and *Liquidambar styraciflua* is rapidly invading. It is apparently the earliest successional forest type to occur at Thomas Stone NHS on all but the driest soils.

USFWS WETLAND SYSTEM      Not applicable

**MOST ABUNDANT SPECIES**

*Thomas Stone NHS*

<u>Stratum</u>	<u>Species</u>
Tree canopy	<i>Liquidambar styraciflua</i>
Shrub	<i>Liquidambar styraciflua</i>

Herbaceous    *Festuca arundinacea*

DIAGNOSTIC SPECIES    *Liquidambar styraciflua*

OTHER CHARACTERISTIC SPECIES    Not noted.

#### VEGETATION DESCRIPTION

*Globally* (from NatureServe Explorer 2001)

This alliance is comprised of a variety of upland forests dominated by *Liquidambar styraciflua* that follow logging, agricultural cropping, or other widespread disturbance. *Quercus* spp. and *Carya* spp. may be present.

#### *Thomas Stone NHS*

This association is described from observation only; plot data were not collected. It is designated as a class for very young forests strongly dominated by sweet gum (*Liquidambar styraciflua*) saplings or pole-sized trees in the canopy (usually with the largest *L. styraciflua* trees less than 25 cm diameter at breast height), and the physiognomic expression at Thomas Stone NHS is perhaps better characterized as a Shrubland. There is little or no discernible stratification of the woody layers. The herbaceous layer is often dominated by tall fescue (*Festuca arundinacea*) and other formerly planted grasses, with other early successional (including "old field") species present. This type includes dense stands of sweet gum saplings of shrub size (< 2 m tall) that have invaded fields that have not been mowed in several years.

This association includes all stands occurring on uplands that are strongly dominated by *Liquidambar styraciflua*. For Thomas Stone NHS, it is differentiated from all other (later seral) associations that may have even-aged *L. styraciflua* as the leading dominant in the tree layer by the absence of a herbaceous layer that shows the patterns of the later seral types

NOTEWORTHY SPECIES    None noted.

CONSERVATION RANK    GW

#### RANK JUSTIFICATION

The association is a common successional forest following cropping or clearcut logging or other severe anthropogenic disturbance.

#### COMMENTS

This type is similar or equivalent to the sweet gum successional forest of southern New Jersey of Collins and Anderson (1994).

A *Liquidambar styraciflua* Shrubland Alliance may be warranted to account for vegetation that occurs from the early years of old field invasion by *L. styraciflua*, in which individuals of *L. styraciflua* are of shrub or sapling size and the herbaceous layer is dominated by shade intolerant ("old field") species.

## PLOTS

None (222 may be included in the global concept of this association)

## ***Betula nigra* Woodland**

COMMON NAME	River Birch Woodland
SYNONYM	Depositional Bar
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	II. Woodland
PHYSIOGNOMIC SUBCLASS	IIB. Deciduous woodland
PHYSIOGNOMIC GROUP	IIB2. Cold-deciduous woodland
PHYSIOGNOMIC SUBGROUP	IIB2N. Natural/Semi-natural cold-deciduous woodland
FORMATION	IB2Nb. Temporarily flooded cold-deciduous woodland
ALLIANCE	II.B.2.N.b.1 <i>Platanus occidentalis</i> - ( <i>Betula nigra</i> , <i>Salix</i> spp.) Temporarily flooded woodland alliance

CLASSIFICATION CONFIDENCE LEVEL 1

### RANGE (alliance)

The *Platanus occidentalis* - (*Betula nigra*, *Salix* spp.) Temporarily Flooded Woodland Alliance is widespread in the southeastern United States (NatureServe Explorer 2001).

### ENVIRONMENTAL DESCRIPTION

This association occurs on depositional bars in stream channels, where it is likely to remain flooded by high flows for long periods (several days to weeks) during the winter and early spring and occasionally during other seasons. Soil is recently deposited relatively coarse alluvium (likely muddy sands, sands, or gravelly sands), with no discernible horizon development.

USFWS WETLAND SYSTEM Palustrine

### MOST ABUNDANT SPECIES

*Thomas Stone NHS*

<u>Stratum</u>	<u>Species</u>
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Tree canopy	<i>Betula nigra</i>
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Herbaceous	<i>Microstegium vimineum</i> , <i>Dichanthelium clandestinum</i>
------------	--

DIAGNOSTIC SPECIES *Betula nigra*

OTHER CHARACTERISTIC SPECIES None noted.

### VEGETATION DESCRIPTION

Globally (adapted from NatureServe Explorer 2001)

The *Platanus occidentalis* - (*Betula nigra*, *Salix spp.*) Temporarily Flooded Woodland Alliance is dominated by some combination of *Platanus occidentalis*, *Betula nigra*, *Salix nigra*, and *Salix caroliniana*.

#### Thomas Stone NHS

Because of the small size of the single occurrence at Thomas Stone NHS and the lack of data on communities of depositional bars within the Coastal Plain, the floristic composition of this type is not well known. Debris-battered and stunted individuals of river birch (*Betula nigra*), which was observed in this occurrence, and sycamore (*Platanus occidentalis*), which occurred in the vicinity, are probably the most numerous and characteristic tree layer species. A shrub layer is either sparse or absent. The herbaceous layer is comprised of disturbance-adapted perennial and annual forbs and grasses. The single occurrence seen at Thomas Stone NHS was heavily overrun by the invasive annual Japanese stilt grass (*Microstegium vimineum*). The perennial deer-tongue grass (*Dichanthelium clandestinum*) was also frequent.

NOTEWORTHY SPECIES None observed.

CONSERVATION RANK Unknown

#### RANK JUSTIFICATION

Further information is needed to define the range and extent of this association range and the corresponding rank.

#### COMMENTS

This type is described from observation only. A single, very small (about 50 m<sup>2</sup>) and degraded example was seen within the channel of Hoghole Run, possibly just outside the boundary of Thomas Stone NHS. The position and species composition clearly indicated that the occurrence was of depositional bar vegetation that would most likely be placed within the *Platanus occidentalis* - (*Betula nigra*, *Salix spp.*) Temporarily Flooded Woodland Alliance.

Depositional bar types in the northeastern United States are not presently precisely defined within the NVCS or in state classification systems. This type would correspond to types within either Sand/Gravel/Mud Bars and Shores, Rocky Bars and Shores, or River-Scour Woodlands of Fleming et al. (2001).

#### PLOTS

None



***Festuca arundinacea* - *Dactylis glomerata* - *Apocynum cannabinum* Herbaceous Vegetation**

COMMON NAME	Tall Fescue - Orchard Grass - Dogbane Herbaceous Vegetation
SYNONYM	Dry Meadow (Hayfield)
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	V. Herbaceous Vegetation
PHYSIOGNOMIC SUBCLASS	VA. Perennial graminoid vegetation
PHYSIOGNOMIC GROUP	VA5. Temperate or subpolar grassland
PHYSIOGNOMIC SUBGROUP	VA5N. Natural/Semi-natural temperate or subpolar grassland or VA5C. Cultivated temperate or subpolar grassland
FORMATION	VA5Nc. or VA5Cc. Medium-tall sod temperate or subpolar grassland
ALLIANCE	VA5Nc8. <i>Festuca</i> spp. Herbaceous Alliance

**CLASSIFICATION CONFIDENCE LEVEL 1**

**RANGE (alliance)**

The *Festuca* spp. Herbaceous Alliance is probably widespread in the eastern United States and southern Canada (NatureServe Explorer 2001).

**ENVIRONMENTAL DESCRIPTION** This is a broadly described association that represents infrequently mowed meadows and pastures. At Thomas Stone NHS, it occurs where the management purpose for vegetation is to maintain the cultural agrarian landscape important to the purposes of the site or to maintain utility line corridors. Mowing frequency is probably annual or less often, in order to allow grasses to grow tall enough to represent pasture or hayfield appearance, but to inhibit woody shrub invasion.

**USFWS WETLAND SYSTEM** Not applicable.

**MOST ABUNDANT SPECIES**

*Thomas Stone NHS*

Stratum      Species

Herbaceous      *Festuca arundinacea*, *Dactylis glomerata*

**DIAGNOSTIC SPECIES** *Festuca arundinacea*, *Dactylis glomerata*

#### OTHER CHARACTERISTIC SPECIES

*Phleum pratense*, *Anthoxanthum odoratum*, *Poa pratensis*, *Setaria glauca*, *Panicum anceps*, *Tridens flavus*, *Andropogon virginicus*, *Solanum carolinense*, *Allium vineale*, *Asclepias syriaca*, *Apocynum cannabinum*, *Liquidambar styraciflua*, *Cyperus echinatus*, *Lespedeza cuneata*, *Diospyros virginiana*, *Daucus carota*, *Eupatorium hyssopifolium*

#### VEGETATION DESCRIPTION

Globally ( from NatureServe Explorer (2001))

The *Festuca* spp. Herbaceous Alliance is characterized by dominance by exotic grasses, which can form nearly monospecific stands, or which may be accompanied by a variety of native graminoids and forbs.

.

*Thomas Stone NHS*

Tall exotic grasses, particularly tall fescue (*Festuca arundinacea*), with orchard grass (*Dactylis glomerata*) and timothy (*Phleum pratense*) also frequent, heavily dominate this type.

Occasionally, patches of native grasses, such as little bluestem (*Schizachyrium scoparium*), broomsedge (*Andropogon virginicus*), beaked panic grass (*Panicum anceps*), and poverty grass (*Danthonia spicata*) are locally dominant, especially on drier areas. Such patches may represent associations different from that described here. Tall, native and exotic, mostly perennial, forbs (old field weeds) are frequent. Since surveys were conducted in mid-summer, fall-blooming species such as members of the genera *Solidago* (goldenrods) and *Aster* (asters) may be better represented than is indicated here.

NOTEWORTHY SPECIES None observed.

CONSERVATION RANK GW

RANK JUSTIFICATION This association is cultural in nature and widespread.

#### COMMENTS

The NVCS places this association in the Natural/Semi-natural subgroup. At Thomas Stone NHS and perhaps other areas, assignment to the Cultivated subgroup might be appropriate.

#### PLOTS

None.

***Dichanthelium clandestinum*** Herbaceous Vegetation

COMMON NAME	Deer-tongue Grass Herbaceous Vegetation
SYNONYM	Wet Meadow
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	V. Herbaceous Vegetation
PHYSIOGNOMIC SUBCLASS	VA. Perennial graminoid vegetation
PHYSIOGNOMIC GROUP	VA5. Temperate or subpolar grassland
PHYSIOGNOMIC SUBGROUP	VA5N. Natural/Semi-natural temperate or subpolar grassland or VA5C. Cultivated temperate or subpolar grassland
FORMATION	VA5Nk. or VA5Ck. Seasonally flooded temperate or subpolar grassland
ALLIANCE	Unknown

CLASSIFICATION CONFIDENCE LEVEL 3

RANGE

Likely to be widespread in mid-Atlantic and southeastern states.

ENVIRONMENTAL DESCRIPTION This type includes all infrequently mowed areas with a high water table. It is most extensive and is primarily situated along the power line right-of-way and other wet, infrequently mowed meadows along the Hoghole Run floodplain, but may also include small-patch damp depressions within the dry meadow type.

USFWS WETLAND SYSTEM Palustrine

MOST ABUNDANT SPECIES

*Thomas Stone NHS*

Stratum Species

Herbaceous *Dichanthelium clandestinum*

DIAGNOSTIC SPECIES *Dichanthelium clandestinum*, *Carex scoparia*, *Rhexia mariana*, *Rhexia virginica*

OTHER CHARACTERISTIC SPECIES

*Carex lurida*, *Carex crinita*, *Rhynchospora capitellata*, *Eleocharis* spp., *Helenium autumnale*, *Verbesina alternifolia*, *Solidago gigantea*, *Solidago rugosa*

#### VEGETATION DESCRIPTION

*Thomas Stone NHS*

This type is dominated by mesic to hydric graminoid species, with a variety of light-demanding forbs also present. It is characterized by a large component of obligate to near-obligate wetland species, by which it is distinguished from the Dry Meadow type.

NOTEWORTHY SPECIES   None noted.

CONSERVATION RANK   GW

RANK JUSTIFICATION   This association is cultural in nature and likely widespread..

#### COMMENTS

This association is tentatively placed in the Cultural subgroup because it persists from maintenance of utility right-of-way. Despite its cultural nature, this type has fairly high species diversity and may support uncommon or rare shade intolerant wetland herbs.

#### PLOTS

None

***Panicum rigidulum* - *Juncus* spp. - *Rhexia virginica* Herbaceous Vegetation**

COMMON NAME	Red-top Panic Grass - Rush - Virginia Meadow Beauty Herbaceous Vegetation
SYNONYM	Pond Shore Marsh
TNC SYSTEM	Terrestrial
PHYSIOGNOMIC CLASS	V. Herbaceous Vegetation
PHYSIOGNOMIC SUBCLASS	VA. Perennial graminoid vegetation
PHYSIOGNOMIC GROUP	VA5. Temperate or subpolar grassland
PHYSIOGNOMIC SUBGROUP	VA5N. Natural/Semi-natural temperate or subpolar grassland
FORMATION	VA5Nk. Seasonally flooded temperate or subpolar grassland
ALLIANCE	VA5Nk23. <i>Rhynchospora</i> spp. - <i>Panicum</i> ( <i>rigidulum</i> , <i>verrucosum</i> ) - <i>Rhexia virginica</i> Seasonally Flooded Herbaceous Alliance

CLASSIFICATION CONFIDENCE LEVEL 2

RANGE (of alliance)

The *Rhynchospora* spp. - *Panicum* (*rigidulum*, *verrucosum*) - *Rhexia virginica* Seasonally Flooded Herbaceous Alliance is widespread in the eastern United States and Canada (NatureServe Explorer 2001).

ENVIRONMENTAL DESCRIPTION This type is confined to the narrow, permanently wet (possibly saturated) zone along the edge of the single pond. The pond and edges are not natural, but the type is likely maintained by inhibition of invasion of woody species by permanent saturation of the soil, and it can probably be regarded as semi-natural within the NVCS.

USFWS WETLAND SYSTEM Palustrine

MOST ABUNDANT SPECIES

Thomas Stone NHS

<u>Strata</u>	<u>Species</u>
Herbaceous	Various

DIAGNOSTIC SPECIES

*Sparganium americanum*

## OTHER CHARACTERISTIC SPECIES

*Scirpus cyperinus*, *Eleocharis obtusa*, *Juncus acuminatus*, *Juncus effusus*, *Panicum rigidulum*, *Leersia virginica*, *Hypericum mutilum*, *Rhexia virginica*, *Rhexia mariana*, *Polygonum punctatum*

## VEGETATION

Globally (adapted from NatureServe Explorer 2001),

The *Rhynchospora* spp. - *Panicum (rigidulum, verrucosum)* - *Rhexia virginica* Seasonally Flooded Herbaceous Alliance occurs on pondshores and lakshores and is usually dominated by graminoid species. Species may exhibit zonation caused by hydrologic gradients.

### Thomas Stone NHS

The single occurrence at Thomas Stone NHS consists of a variety of wetland herbs (listed above), and is dominated by graminoids. Some zonation is apparent, with the taller species, American bur-reed (*Sparganium americanum*) and wool-grass (*Scirpus cyperinus*), occurring mostly in wetter zones. Some species identified as typical for the alliance (NatureServe Explorer 2001), which occur at Thomas Stone NHS are cow-kill (*Eleocharis obtusa*), soft rush (*Juncus effusus*), other rushes (*Juncus* spp.), meadow beauties (*Rhexia virginica*, *R. mariana*), and wool-grass (*Scirpus cyperinus*).

NOTEWORTHY SPECIES None noted.

CONSERVATION RANK Unknown

RANK JUSTIFICATION This association is probably frequent and semi-natural, as described, but may occur in more natural settings.

## COMMENTS

The assignment of this vegetation could be to one of several alliances, but it appears to be a common (semi-natural) type within the alliance proposed here. Most associations described for these alliances are comprised of natural vegetation, and some are regionally or globally rare.

The wetter parts of this type, including those with *Sparganium americanum* might be treated as a narrow zone of a more hydric association.

*Rhynchospora capitellata*, which is a nominal species for several associations in the *Rhynchospora* spp. - *Panicum (rigidulum, verrucosum)* - *Rhexia virginica* Seasonally Flooded Herbaceous Alliance, was not observed in this vegetation at Thomas Stone NHS, but occurs in wet meadows at the site.

## PLOTS

None

***Festuca arundinacea* - *Poa pratensis* - *Trifolium repens* Herbaceous Vegetation**

COMMON NAME Tall Fescue - Kentucky Bluegrass - Sweet Clover  
Herbaceous Vegetation

SYNONYM Lawn

TNC SYSTEM Terrestrial

PHYSIOGNOMIC CLASS V. Herbaceous Vegetation

PHYSIOGNOMIC SUBCLASS VA. Perennial graminoid vegetation

PHYSIOGNOMIC GROUP VA5. Temperate or subpolar grassland

PHYSIOGNOMIC SUBGROUP VA5C. Cultivated temperate or subpolar grassland

FORMATION VA5Nc. Temperate or subpolar grassland

ALLIANCE Unknown

CLASSIFICATION CONFIDENCE LEVEL 3

**RANGE**

Although apparently not defined within the NVCS, this vegetation is undoubtedly widespread throughout the eastern United States and Canada.

**ENVIRONMENTAL DESCRIPTION** This type represents lawn areas that are regularly mowed (probably at a frequency of less than one month during the spring and summer). At Thomas Stone NHS, they occur mainly in the vicinity of the Stone mansion, near other buildings, and along road edges.

USFWS WETLAND SYSTEM Not applicable

**MOST ABUNDANT SPECIES**

*Thomas Stone NHS*

Stratum Species

Herbaceous *Festuca arundinacea*, *Poa pratensis*, *Trifolium repens*

**DIAGNOSTIC SPECIES** *Festuca arundinacea*, *Poa pratensis*, *Trifolium repens*, *Digitaria sanguinalis*, *Eleusine indica*

**OTHER CHARACTERISTIC SPECIES** None noted.

**VEGETATION DESCRIPTION**

Vegetation composition is described from observation only. It is comprised of exotic lawn grasses, which are generally dominant and kept mowed at a low stature. Exotic (primarily) and native weeds are frequent, but the species richness is fairly low.

NOTEWORTHY SPECIES None noted.

CONSERVATION RANK GW

RANK JUSTIFICATION This association is widespread and cultural.

COMMENTS

None.

PLOTS

None.



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## Glossary

**calciphilic** - preferring soils with high calcium content (e.g., limestone soils)

**canopy** - the layer formed by treetops; may be divided into separate strata to describe different heights (e.g., canopy and subcanopy)

**characteristic species** - a species that occurs in many of the examples of a particular vegetation association; not related to abundance or dominance; the species may be sparse to abundant.

**codominant** - a species with relatively high abundance or percent cover shares dominance with one or several other species; typically refers to a given strata (e.g., beech, red oak and tulip tree are codominant in the canopy)

**community** - as used in this document, a specific, spatially distinct example of an association (Grossman et al. 1998); approximately equivalent to stand

**cover** (often expressed as percent cover) - aerial projection of the amount of ground surface that is covered or shadowed by a plant or a stratum (e.g., shrub stratum or layer)

**diagnostic species** - a characteristic species that is strongly or somewhat partial to a vegetation association, so that its presence is a useful indicator of the association

**dominant** - the one to several species with the most abundant or highest percent cover; often comprising over 50% cover overall or in a given stratum

**ericaceous** - plants belonging to the heath family (see "heath")

**exotic** - term used to describe a species that is not naturally occurring or native to the area (e.g., Rock Creek Park or vicinity); introduced; escaped from cultivation.

**fragipan** - a dense layer in the subsoil that has a high clay content, from weathering and deposition of clay from the upper soil layers; often restricts rooting of plants and water drainage; also called clay pan or hardpan

**graminoid** - herbaceous plants with a grass-like growth form (long, narrow leaves), including grasses, sedges, and rushes

**hardwood** - deciduous, non-coniferous tree

**heath** - member of the heath family (Ericaceae); includes a number of common shrubs such as blueberry, huckleberry, azalea and mountain laurel and some herbs such as wintergreen (*Gaultheria procumbens*).

**herb** - a non-woody plant; an herbaceous plant

**herbaceous layer** - ground vegetation stratum comprised primarily of non-woody vegetation (herbs)

**hydric** - areas with wet or seasonally flooded soils; wetland soils

**leading dominant** - the individual species with the most abundant or highest percent cover

**mesic** - areas with moist, well-drained soils; neither hydric (e.g., wet, saturated, seasonally flooded) nor xeric (dry, droughty)

**obligate** - species that are restricted to a specific set of conditions (e.g., obligate wetland species)

**shrub layer** - the vegetation stratum formed by the tops of shrubs

**stand** - a spatially discrete occurrence of uniform vegetation (as used here, the vegetation is from a single association)

**stratum** (pl., **strata**) - layer of vegetation; commonly defined strata are: canopy, subcanopy, shrub (tall shrub over 2 meters, short shrub less than 2 meters), herbaceous and vine

**subcanopy** - the stratum formed by treetops below the canopy layer

**tree layer** - the canopy and subcanopy combined

**xeric** - describing areas with dry, well-drained soils

Table 1. Soil mapping units of Thomas Stone NHS.

Abbreviation

(Figure 3 Legend) Soil Mapping Unit

AuD3 Aura gravelly sandy loam, 5-15% slopes, severely eroded

BlB2 Beltsville silt loam, 2-5% slopes, moderately eroded

BIC2 Beltsville silt loam, 5-10% slopes, moderately eroded

BIC3 Beltsville silt loam, 5-10% slopes, severely eroded

BoBibb silt loam

CrC3 Croom gravelly loam, 8-15% slopes, severely eroded

ExC2 Exum silt loam, 5-10% slopes, moderately eroded

EzB2 Exum-Beltsville silt loams, 2-5% slopes, moderately eroded

MtA Mattapex fine sandy loam, 0-2% slopes, moderately eroded

MtB2 Mattapex fine sandy loam, 2-5% slopes, moderately eroded

ShB2 Sassafras sandy loam, 2-5% slopes, moderately eroded

ShC2 Sassafras sandy loam, 5-10% slopes, moderately eroded

w Water

Table 2. Location and tentative classification of rapid assessment vegetation observation points at Thomas Stone National Historic Site (easting and northing units are UTM meters, NAD-83).

#	Easting	Northing	Association	#	Easting	Northing	Association
01	322251.8	4266663.6	Lawn	39	322687.7	4266365.5	Dry Oak-Beech
02	322282.9	4266655.1	Lawn	40	322704.7	4266317.4	Dry Mesic
03	322298.3	4266752.4	Dry Meadow	41	322805.9	4265946.7	Dry Mesic
04	322343.5	4266738.6	Dry Meadow	42	322840.5	4265908.7	Sweet Gum
05	322421.9	4266740.0	Dry Meadow	43	322778.7	4265921.7	Dry Mesic
06	322478.1	4266710.6	Dry Meadow	44	322734.4	4265926.4	Dry Mesic
07	322492.0	4266644.8	Seepage Swamp	45	322748.7	4265966.9	Dry Mesic
08	322495.1	4266583.4	Dry Oak-Beech	46	322685.5	4265872.6	Dry Mesic
09	322483.5	4266539.4	Dry Oak-Beech	47	322603.5	4265763.3	Dry Mesic
10	322447.8	4266560.7	Dry Oak-Beech	48	322477.0	4265681.0	Ravine Bottom
11	322451.3	4266526.3	Dry Oak-Beech	49	322469.0	4265718.0	Dry Mesic
12	322408.8	4266511.9	Pine-Oak	50	322510.0	4265771.0	Tulip Tree
13	322372.3	4266526.0	Dry Oak-Beech	51	322584.0	4265796.0	Tulip Tree
14	322323.4	4266538.7	Ravine Bottom	52	322572.0	4265855.0	Tulip Tree
15	322324.8	4266490.3	Dry Oak-Beech	53	322634.0	4265869.0	Ravine Bottom
16	322347.1	4266480.9	Pine-Oak	54	322616.0	4265916.0	Dry Mesic
17	322349.2	4266432.5	Pine-Oak	55	322706.0	4265992.0	Ravine Bottom
18	322379.7	4266415.0	Pine-Oak	56	322656.0	4266014.0	Dry Mesic
19	322408.0	4266391.0	Pine-Oak	57	322669.0	4266136.0	Dry Oak-Beech
20	322453.6	4266412.9	Dry Oak-Beech	58	322653.0	4266111.0	Dry Mesic
21	322437.5	4266354.1	Pine-Oak	59	322746.0	4266089.0	Ravine Bottom
22	322436.0	4266352.8	Pine-Oak	60	322554.0	4266249.5	Dry Oak-Beech
23	322447.9	4266211.8	Dry Meadow	61	322409.5	4266062.3	Tulip Tree
24	322456.9	4266123.5	Dry Meadow	62	322048.4	4267028.1	Tulip Tree
25	322384.1	4265997.7	Tulip Tree	63	321978.7	4267039.5	Ravine Bottom
26	322350.5	4266006.2	Tulip Tree	64	321932.4	4267047.4	Dry Mesic
27	322349.6	4266024.6	Tulip Tree	65	321872.3	4267068.5	Floodplain Swamp
28	322316.3	4266052.7	Tulip Tree	66	321857.9	4266987.9	Dry Mesic
29	322309.2	4266094.9	Tulip Tree	67	321822.4	4266896.7	Floodplain Swamp
30	322309.7	4266152.0	Tulip Tree	68	321806.1	4266848.3	Floodplain Swamp
31	322347.5	4266140.5	Tulip Tree	69	322127.8	4267208.3	Dry Oak-Beech
32	322200.6	4266071.5	Ravine Bottom	70	322166.7	4267158.2	Tulip Tree
33	322197.7	4266034.2	Wet Meadow	71	322428.3	4265695.0	Dry Mesic
34	322109.3	4266175.5	Ravine Bottom	72	322357.5	4265780.3	Tulip Tree
35	322062.7	4266218.5	Ravine Bottom	73	322347.5	4265882.8	Dry Mesic
36	322061.2	4266366.1	Tulip Tree	74	322455.0	4266600.9	Seepage Swamp
37	322675.4	4266679.7	Oak-Heath	75	322321.0	4266541.0	Ravine Bottom
38	322708.3	4266430.7	Dry Oak-Beech	76	322244.0	4267101.9	Sweet Gum

TWINSPAN output tables (Hill 1979; McCune and Mefford 1997) for analysis of 59 vegetation observation (rapid assessment) data from Thomas Stone NHS, showing plot abundance scores for 100 most frequent species and final point assignment.

[illegible]



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00111	01111		001111

Table 4. Location, date, personnel, and classification of vegetation and environmental plots at Thomas Stone National Historic Site (easting and northing units are UTM meters, NAD-83). All plots are 16m x 25m, unless otherwise noted.

Plot #	Easting	Northing	Survey Date	Vegetation Surveyors	Association
131	322479.0	4266551.7	7/16/2001	Cass, Gounaris, Loncosky, Hamilton, Morawe	Dry Oak-Beech
201	322341.7	4266477.3	7/17/2001	Gounaris, Hamilton	Pine-Oak
202	322072.4	4266366.3	7/17/2001	Gounaris, Hamilton	Tulip Tree
211	322332.1	4266430.6	7/17/2001	Cass, Loncosky	Pine-Oak
212	322130.4	4266392.0	7/17/2001	Cass, Loncosky	Tulip Tree
221*	322278.5	4266509.3	7/17/2001	Steury, Morawe	Seepage Swamp
222	322064.5	4266217.9	7/17/2001	Steury, Morawe	Ravine Bottom
301	322782.6	4266025.8	7/18/2001	Cass, Hamilton	Dry Mesic
302	322712.8	4265967.5	7/18/2001	Cass, Hamilton	Ravine Bottom
311	322689.8	4266069.4	7/18/2001	Gounaris, Loncosky	Dry Mesic
312	322674.9	4265927.9	7/18/2001	Gounaris, Loncosky	Ravine Bottom
321*	322142.4	4266763.5	7/18/2001	Steury, Morawe	Seepage Swamp
322	322611.3	4265782.1	7/18/2001	Steury, Morawe	Dry Mesic
401	322346.8	4266004.4	7/19/2001	Cass, Hamilton	Tulip Tree
402	322501.1	4266383.1	7/19/2001	Cass, Hamilton	Dry Oak-Beech
411	322292.8	4266128.3	7/19/2001	Gounaris, Loncosky	Tulip Tree
412	322562.2	4266237.1	7/19/2001	Gounaris, Loncosky	Dry Oak-Beech
421	322164.5	4266090.0	7/19/2001	Steury, Morawe	Ravine Bottom
422	322649.9	4266249.9	7/19/2001	Steury, Morawe	Dry Oak-Beech
431	322607.6	4266690.6	7/19/2001	Loncosky, Hamilton, Lea	Oak-Heath
501	322598.8	4266765.6	7/20/2001	Loncosky, Hamilton, Lea	Oak-Heath
502**	321796.2	4266870.8	7/20/2001	Lea, Hamilton	Floodplain Swamp
511	321799.1	4266808.3	7/20/2001	Steury, Morawe	Floodplain Swamp
601	322788.9	4266484.9	8/01/2001	Lea	Pine-Oak
602	322845.0	4266457.0	8/01/2001	Lea	Oak-Heath
603	322775.8	4266629.2	8/01/2001	Lea	Upland Depression Swamp

\* - 100 m<sup>2</sup> plots

\*\* - 12m x 32m plot

Table 5. TWINSpan output tables (see Hill 1979; McCune and Mefford 1997) for analysis of 23 vegetation plots at Thomas Stone NHS, showing plot abundance scores for 100 most frequent species and final plot assignment. Three plots (221, 321, and 603) were excluded as outliers.

	Plot number (read down)		
	35542234333424422461456		
	00120110012120101203300		
	22112221112122211211112		
Species			COLOR LEGEND (PLOTS AND SPECIES SCORES)
Vitis vulpina	-1-422-2---2-----1----	000000	Floodplain Swamp
Asplenium platyneuron	---23222---2-----	000001	Ravine Bottom
Botrychium dissectum	2---222-----1-----	000001	Tulip Tree
Botrychium virginianum	--222222---2-----	000001	Dry Mesic
Campsis radicans	-2-22212--2-----	000001	Dry Oak-Beech
Circaea lutetiana	1-223222--2-----	000001	Pine-Oak
Duchesnea indica	--211-22-----	000001	Oak-Heath
Elymus virginicus	---21-2-----	000001	
Erechtites hieraciifolia	---2-21-----	000001	
Oxalis stricta	--22-212-----	000001	
Platanus occidentalis	-5-4--44-----	000001	
Sanicula canadensis	--22221--2-----	000001	
Carex radiata	6232-332---2-----	000010	
Cryptotaenia canadensis	--21--2-----	000010	
Geum canadense	-12221-----1-----	000010	
Onoclea sensibilis	222222-----	000010	
Dichanthelium boscii	2---31-----	000010	
Dichanthelium clandestinum	-2222-----	000010	
Polygonum cespitosum	4--2--23---1-----	000010	
Polygonum virginianum	-22222-----2-----	000010	
Rubus hispidus	22-23222-2---1-----	000010	
Viola sororia	2-2222-3-2-----	000010	
Betula nigra	-66-----	000011	
Boehmeria cylindrica	6432--2-----	000011	
Carex lurida	-222-----	000011	
Carex tribuloides	2332--2-----	000011	
Glyceria striata	262-----	000011	
Arisaema triphyllum	32332225-2223-----	000100	
Festuca subverticillata	2-223322-2221-----	000100	
Galium tinctorium	22222212--22-----	000100	
Juglans nigra	---32-----2-----	000100	
Lindera benzoin	67767868-2253-----	000100	
Lonicera japonica	22233222-2-22-----	000100	
Galium circaezans	---22-3-2-2-----	000101	
Microstegium vimineum	-1-2--2--12-----	000101	
Athyrium felix-femina	3222--2-----3-----	000110	
Carex debilis	-42-22--1--2-----	000110	
Carex intumescens	-33---2---2-----	000110	
Carex seorsa	--22-----2-----	000110	
Carpinus caroliniana	677216464444-12-----	000110	
Cinna arundinacea	27-----2-----	000110	
Impatiens capensis	212-----2-----	000110	
Leersia virginica	34---2---2-----	000110	
Lycopus virginicus	222-----1-1-----	000110	
	000000000000011111111111		
	000000001111100000111111		

	00011111000010011101111 01111		
	Plot number (read down)		
	35542234333424422461456 00120110012120101203300 22112221112122211211112		
Species		COLOR LEGEND (PLOTS AND SPECIES SCORES)	
Muhlenbergia schreberi	2-22--1-3-----	000110	Floodplain Swamp
Dichanthelium dichotomum	2122---2---2-----	000110	Ravine Bottom
Solidago rugosa	-222-----2-----	000110	Tulip Tree
Ulmus americana	54--3-1-1--2-----	000110	Dry Mesic
Symphotrichum lanceolatum	1222-----1-1-----	000111	Dry Oak-Beech
Carex laxiculmis	2-2---2--2---1-----	000111	Pine-Oak
Carya cordiformis	6251---6---41-3-----	000111	Oak-Heath
Carex albolutescens	21--21---2-3-----	001000	
Polystichum acrostichoides	422222222322-----	001000	
Thelypteris noveboracensis	5433-----6-7-----	001000	
Vitis labrusca	-12---1--2-2-----	001000	
Quercus rubra	4---1174612-----	001001	
Luzula echinata	--2---2---2-----	001010	
Lycopodium digitatum	-----2-3-----	001010	
Carex digitalis	-----2-222-----	001011	
Desmodium nudiflorum	-----122-----	001011	
Goodyera pubescens	-----222-1-----	001011	
Cornus florida	---562-64437--33-----	0011	
Liriodendron tulipifera	66778976475731234321---	0011	
Euonymus americana	222-2--2-2212--2-2-----	0100	
Asimina triloba	42-73263435422221222-2-	01010	
Liquidambar styraciflua	8665562656477156542-31-	01010	
Parthenocissus quinquefolia	2223222322222222-2121--	01010	
Toxicodendron radicans	-3222222212-22-1-----	01010	
Smilax rotundifolia	23262222222324--212-22	01011	
Sassafras albidum	---23--132-24-1121-211-	011	
Carex albicans (sensu lato)	---22-1-222--12--222---	1000	
Carex swanii	22-2222222223222122---	1000	
Mitchella repens	-1---2-22-213--2222----	1000	
Prunus serotina	-1-3211---131--312-2---	1000	
Acer rubrum	78465463765475655567256	1001	
Ilex opaca	51323532724652244452474	1001	
Smilax glauca	2-22-222222222222222-1	1001	
Carya alba	---222-462--6-336----	101	
Fraxinus americana	-2--311-----6-----	101	
Monotropa uniflora	-----22--21-----	101	
Uvularia sessilifolia	-----2-22-----22-1----	101	
Diospyros virginiana	-----4-2--12-----	1100	
Quercus falcata	---2-----5-446-25-----	1100	
Quercus stellata	-----4-6-----	1100	
Danthonia spicata	-----3---22-2121----	1101	
Fagus grandifolia	4---344-77775878966627	1101	
Juniperus virginiana	-1-1---1--33-322-21--2	1101	
Nyssa sylvatica	-----4-365352322474775	1101	
Chimaphila maculata	-----2--1-2--21222-222-	11100	
Quercus alba	--4-----654-1774-778877	11100	
Quercus velutina	---4---4---2655-2256-	11100	
Vaccinium pallidum	-----2-2--222222--2	11100	
	00000000000001111111111		

Species

Amelanchier arborea  
Gaylussacia baccata  
Quercus coccinea  
Vaccinium stamineum  
Kalmia latifolia  
Pinus virginiana  
Carya glabra  
Carex willdenowii

00000000111110000011111  
00011111000010011101111  
01111

Plot number (read down)

35542234333424422461456  
00120110012120101203300  
22112221112122211211112

COLOR LEGEND(PLOTS  
AND SPECIES SCORES)

-----1-----2212-2-	111010	Floodplain Swamp
-----3-22224787	111010	Ravine Bottom
-----55--4626	111010	Tulip Tree
-----22222-342	111010	Dry Mesic
-----2-7-3	111011	Dry Oak-Beech
-----2-8854-662	111100	Pine-Oak
---2---34-51---	111101	Oak-Heath
---2--123---	11111	

0000000000001111111111  
00000000111110000011111  
00011111000010011101111  
01111

[illegible]

100.0 71.0 70.3  
100.0 62.3  
100.0

Classification Abbreviations:

- and Depression Swamp

age Swamp

dplain Swamp Forest

ine Bottom Forest
- TT: Tulip Tree Forest

DM: Dry Mesic Forest

OB: Dry Oak-Beech Forest

PO: Pine-Oak Forest
- OH: Oak-Heath Forest

Table 7. Frequency of stands at Thomas Stone NHS (from plots and rapid assessment observation points) by soil series (see Figure 5) and topographic position.

Topographic Position

→ [(LEVEL] UPLANDS

SLOPES

BOTTOMLANDS

Series →

(% of site mapped as the series) Beltsville silt loams

(57.5%) Exum silt loams (5.2%) Sassafras sandy loams (3.1%) Aura gravelly sandy loams

(24.4%) Croom gravelly loams (3.8%) Mattapex fine sandy loams

(3.4%) Bibb silt loams (2.6%)

Oak-Heath 4

Dry Oak-Beech 14 2

Pine-Oak 9

Dry Mesic 2 13 2 1

Tulip Tree 2 17 1

Ravine bottom 7 2 1

Floodplain 1 6

Depression Swamp 3

Seepage Swamp 2



Table 8. List of taxa recorded in plots. Nomenclature follows U.S. Department of Agriculture (2001).

*Acer rubrum* L.  
*Agrimonia parviflora* Ait.  
*Amelanchier arborea* (Michx. f.) Fern.  
*Amphicarpaea bracteata* (L.) Fern.  
*Aralia spinosa* L.  
*Arisaema triphyllum* (L.) Schott  
*Asimina triloba* (L.) Dunal  
*Asplenium platyneuron* (L.) B.S.P.  
*Athyrium filix-femina* (L.) Roth  
*Berberis thunbergii* DC.  
*Betula nigra* L.  
*Boehmeria cylindrica* (L.) Sw.  
*Botrychium dissectum* Spreng.  
    var. *obliquum* (Muhl. ex Willd.) Clute  
*Botrychium virginianum* (L.) Sw.  
*Campsis radicans* (L.) Seem. ex Bureau  
*Carex albicans* Willd. ex Spreng.  
*Carex albolutescens* Schwein.  
*Carex amphibola* Steud.  
*Carex atlantica* Bailey ssp. *atlantica*  
*Carex cephalophora* Muhl. ex Willd.  
*Carex complanata* Torr. & Hook.  
*Carex crinita* Lam. var. *brevicrinis* Fern.  
*Carex crinita* Lam. var. *crinita*  
*Carex debilis* Michx.  
*Carex digitalis* Willd.  
*Carex intumescens* Rudge  
*Carex laevivaginata* (Kuk.) Mack.  
*Carex laxiculmis* Schwein.  
*Carex laxiflora* Lam.  
*Carex longii* Mack.  
*Carex lurida* Wahlenb.  
*Carex radiata* (Wahlenb.) Small  
*Carex seorsa* Howe  
*Carex squarrosa* L.  
*Carex styloflexa* Buckl.  
*Carex swanii* (Fern.) Mack.  
*Carex tribuloides* Wahlenb.  
*Carex willdenowii* Schkuhr ex Willd.  
*Carpinus caroliniana* Walt.  
*Carya cordiformis* (Wangenh.) K. Koch  
*Carya alba* (L.) Nutt. ex Ell.  
*Carya glabra* (P. Mill.) Sweet  
*Chasmanthium laxum* (L.) Yates  
*Chelone glabra* L.  
*Chimaphila maculata* (L.) Pursh

*Chimaphila umbellata* (L.) W. Bart.  
*Chionanthus virginicus* L.  
*Cicuta maculata* L.  
*Cinna arundinacea* L.  
*Circaea lutetiana* L.  
*Cirsium* P. Mill. sp.  
*Clematis virginiana* L.  
*Clethra alnifolia* L.  
*Commelina communis* L.  
*Cornus florida* L.  
*Cryptotaenia canadensis* (L.) DC.  
*Cypripedium acaule* Ait.  
*Cystopteris protrusa* (Weatherby) Blasdel  
*Danthonia spicata* (L.) Beauv. ex Roemer &  
 J.A. Schultes  
*Dennstaedtia punctilobula* (Michx.) T. Moore  
*Desmodium nudiflorum* (L.) DC.  
*Dichanthelium boscii* (Poir.) Gould & C.A. Clark  
*Dichanthelium clandestinum* (L.) Gould  
*Dichanthelium commutatum* (J. A. Schultes)  
 Gould  
*Dichanthelium dichotomum* (L.) Gould *Dioscorea villosa* L.  
*Diospyros virginiana* L.  
*Duchesnea indica* (Andr.) Focke  
*Elymus villosus* Muhl. ex Willd.  
*Elymus virginicus* L.  
*Epifagus virginiana* (L.) W. Bart.  
*Erechtites hieraciifolia* (L.) Raf. ex DC.  
*Euonymus americana* L.  
*Eupatorium perfoliatum* L.  
*Fagus grandifolia* Ehrh.  
*Festuca subverticillata* (Pers.) Alexeev  
*Fraxinus americana* L.  
*Galium circaezans* Michx.  
*Galium pilosum* Ait.  
*Galium tinctorium* L.  
*Galium triflorum* Michx.  
*Gaylussacia baccata* (Wangenh.) K. Koch  
*Geum canadense* Jacq.  
*Glyceria striata* (Lam.) A.S. Hitchc.  
*Goodyera pubescens* (Willd.) R. Br. ex  
 Ait. f.  
*Hieracium paniculatum* L.  
*Houstonia caerulea* L.  
*Hypericum punctatum* Lam.  
*Ilex opaca* Ait.

*Ilex verticillata* (L.) Gray  
*Impatiens capensis* Meerb.  
*Juglans nigra* L.  
*Juncus effusus* L.  
*Juncus tenuis* Willd.  
*Juniperus virginiana* L.  
*Kalmia latifolia* L.  
*Leersia virginica* Willd.  
*Ligustrum* L. sp.  
*Lindera benzoin* (L.) Blume  
*Liquidambar styraciflua* L.  
*Liriodendron tulipifera* L.  
*Lobelia* (cf) *inflata* L.  
*Lobelia cardinalis* L.  
*Lonicera japonica* Thunb.  
*Ludwigia palustris* (L.) Ell.  
*Luzula echinata* L.  
*Lycopodium digitatum* Dill. ex A. Braun  
*Lycopodium obscurum* L.  
*Lycopus virginicus* L.  
*Magnolia virginiana* L.  
*Maianthemum racemosum* (L.) Link  
*Medeola virginiana* L.  
*Menispermum canadense* L.  
*Microstegium vimineum* (Trin.) A. Camus  
*Mimulus ringens* L.  
*Mitchella repens* L.  
*Monotropa hypopithys* L.  
*Monotropa uniflora* L.  
*Muhlenbergia schreberi* J. F. Gmel.  
*Nyssa sylvatica* Marsh.  
*Onoclea sensibilis* L.  
*Ophioglossum vulgatum* L.  
*Osmorhiza claytonii* (Michx.) C. B. Clarke  
*Osmorhiza longistylis* (Torr.) DC.  
*Osmunda cinnamomea* L.  
*Oxalis stricta* L.  
*Oxypolis rigidior* (L.) Raf.  
*Parthenocissus quinquefolia* (L.) Planch.  
*Phytolacca americana* L.  
*Pilea pumila* (L.) Gray  
*Pinus virginiana* P. Mill.  
*Platanus occidentalis* L.  
*Poa* (cf) *cuspidata* Nutt.  
*Podophyllum peltatum* L.  
*Polygonum caespitosum* Blume

*Polygonum sagittatum* L.  
*Polygonum virginianum* L.  
*Polygonum*(cf) *punctatum* Ell.  
*Polystichum acrostichoides* (Michx.) Schott  
*Populus grandidentata* Michx.  
*Potentilla simplex* Michx.  
*Prunus serotina* Ehrh.  
*Quercus alba* L.  
*Quercus coccinea* Muenchh.  
*Quercus falcata* Michx.  
*Quercus marilandica* Muenchh.  
*Quercus palustris* Muenchh.  
*Quercus phellos* L.  
*Quercus rubra* L.  
*Quercus stellata* Wangenh.  
*Quercus velutina* Lam.  
*Ranunculus abortivus* L.  
*Ranunculus recurvatus* Poir.  
*Rhododendron periclymenoides*  
(Michx.) Shinnars  
*Robinia pseudoacacia* L.  
*Rosa multiflora* Thunb. ex Murr.  
*Rubus hispidus* L.  
*Rubus occidentalis* L.  
*Rubus pensilvanicus* Poir.  
*Rubus phoenicolasus* Maxim.  
*Sambucus nigra* L. ssp. *canadensis* (L.) R. Bolli  
*Sanicula canadensis* L.  
*Sassafras albidum* (Nutt.) Nees  
*Scirpus cyperinus* (L.) Kunth  
*Scirpus polyphyllus* Vahl  
*Scutellaria integrifolia* L.  
*Scutellaria lateriflora* L.  
*Sisyrinchium angustifolium* P. Mill.  
*Smilax glauca* Walt.  
*Smilax rotundifolia* L.  
*Solidago gigantea* Ait.  
*Solidago rugosa* P. Mill.  
*Stellaria pubera* Michx.  
*Symphotrichum divaricatum* (Nutt.)  
Nesom  
*Symphotrichum lanceolatum* (Willd.)  
Nesom  
*Symplocarpus foetidus* (L.) Salisb. ex Nutt.  
*Thelypteris noveboracensis* (L.) Nieuwl.  
*Tilia americana* L.

*Tipularia discolor* (Pursh) Nutt.  
*Toxicodendron radicans* (L.) Chintz  
*Ulmus americana* L.  
*Uvularia sessilifolia* L.  
*Vaccinium corymbosum* L.  
*Vaccinium pallidum* Ait.  
*Vaccinium stamineum* L.  
*Verbesina alternifolia* (L.) Britt. ex  
Kearney  
*Viburnum acerifolium* L.  
*Viburnum dentatum* L.  
*Viburnum nudum* L.  
*Viburnum prunifolium* L.  
*Viola cucullata* Ait.  
*Viola* x *primulifolia* L. (*pro. sp.*)  
*Viola pubescens* Ait  
*Viola sororia* Willd.  
*Vitis labrusca* L.  
*Vitis vulpina* L.  
*Woodwardia areolata* (L.) T. Moore



Figure 2. Land cover of Thomas Stone National Historical Site (false color infrared, after leaf fall). Image from U. S. Geological Survey digital ortho quarter quad data. White lines depict park boundary.





Figure 3. Vegetation observation points, rapid assessment, Thomas Stone National Historic Site. Blue lines depict streams and ponds; black lines depict park boundary; brown lines and magenta lines depict roads.



Figure 4. Vegetation and environmental data plots at Thomas Stone National Historical Site. Blue lines depict streams and ponds; black lines depict park boundaries; brown lines and magenta lines depict roads.



Figure 5. Soil map of Thomas Stone National Historical Site. (Legend abbreviations follow Table 1). Data courtesy of Natural Resources Conservation Service. Contour interval = 3.05 meters (10 feet).



